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ABSTRACT

The objectives of this study which was conducted as part of the UCLA Allied Health Professions Project were: (1) to determine the percent of medical laboratory workers who perform a comprehensive list of tasks and procedures; (2) to evaluate this performance in terms of certification and specialty area; and (3) on the basis of these data, to make recommendations on curriculum for medical laboratory personnel. A National Technical Advisory Committee, representing leaders in the medical laboratory field, was established, a survey instrument was developed, based on a task inventory of medical laboratory occupations, and a national survey of various types of laboratory facilities was conducted. The survey data, evaluated as a basis for curriculum development, established that: (1) Routine tasks include equipment maintenance, specimen processing, and the use of laboratory equipment, (2) Tasks in the four clinical areas of urinalysis, hematology, microbiology, and biochemistry could serve as a basic curriculum for beginning students, (3) Some difficult training procedures should be delayed until the educational background is developed, and (4) A yearly curriculum review is necessary to insure continued relevance to educational needs. Numerous tables present the data. (Author/AG)

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A STUDY OF THE

CLINICAL LABORATORY OCCUPATIONS

USOE RESEARCH AND DEMONSTRATION

GRANT 8-0627

UNIVERSITY OF CALIFORNIA, LOS ANGELES

DIVISION OF VOCATIONAL EDUCATION

ALLIED HEALTH PROFESSIONS PROJECT

AUGUST 1971

UNIVERSITY OF CALIFORNIA, LOS ANGELES
Division of Vocational Education

ALLIED HEALTH PROFESSIONS PROJECT

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A STUDY OF THE CLINICAL LABORATORY OCCUPATIONS

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August 1971

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F O R E W O R D

The Division of Vocational Education, University of California, is an administrative unit of the University concerned with responsibilities for research, teacher education, and public service in the broad area of vocational and technical education. During 1968 the Division entered into an agreement with the U. S. Office of Education to prepare curricula and instructional materials for a variety of allied health occupations. For the most part, such materials are related to pre-service and in-service instruction for programs ranging from on-the-job training through the Associate degree level.

This report is a summary of the functional analysis for the Clinical Laboratory occupations in the health care facility. A National Technical Advisory Committee provided assistance in designing a questionnaire that was used to identify the various individuals currently performing laboratory functions in hospitals and independent laboratories, and to validate a task list appropriate to the Clinical Laboratory occupations throughout the nation.

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SUMMARY

OBJECTIVES:

1. To determine the percent of medical laboratory workers who perform a comprehensive list of tasks and procedures.

2. To evaluate this performance in terms of certification and specialty area.

3. On the basis of these data, to make recommendations on curriculum for medical laboratory personnel.

PROCEDURE:

1. Establish a National Technical Advisory Committee, representing laboratory directors, medical technologists, consultants, and educators in the medical laboratory field.

2. Develop a survey instrument based on a task inventory of medical laboratory occupations.

3. Conduct a national survey of various types of laboratory facilities.

4. Evaluate the survey data as a basis for curriculum development.

FINDINGS AND RECOMMENDATIONS:

1. The majority of the respondents perform general tasks that can be grouped under the following headings:

   A. Maintain materials and equipment.

   B. Processing specimens

   C. Using standard laboratory equipment

   It is recommended that laboratory personnel receive training in the basic skills necessary to clean glassware chemically; sterilize equipment; inventory supplies; label, log, distribute, and mail clinical specimens; and accurately perform weight, volume, and temperature measurements.

2. The majority of respondents perform the following routine tasks in four laboratory departments or clinical areas:

   A. Urinalysis Clinical Area: routine urinalysis

   B. Hematology Clinical Area: blood counts, sedimentation rate, and simple coagulation studies

C. Microbiology Clinical Area: inoculating and incubating cultures

D. Biochemistry Clinical Area: a simple chemical assay

The tasks in the four clinical areas could serve as a basic curriculum for those students entering the field.

3. Most non-certified workers do not perform the relatively difficult, non-routine tests in the clinical areas of Hematology, Microbiology, and Biochemistry. It is suggested that training for these procedures be delayed until the individual has the educational background for certification or when more intensive on-the-job training is made available.

4. Some procedures in most clinical areas are performed by less than 25 percent of all classifications of respondents. These are either highly specialized research tasks or tasks that are becoming obsolete. Conversely, there are new procedures and techniques which laboratory workers will be expected to perform. Medical laboratory education and training facilities should regularly (at least once a year) review and change curricula to reflect current needs in the field.

A STUDY OF THE CLINICAL LABORATORY OCCUPATIONS

I. INTRODUCTION

The fundamental objectives of the Allied Health Professions Projects are to develop curricula and instructional materials for those allied health functions that can be taught to the Associate degree level, and to develop in-service and pre-service instructional programs for those health-related occupations for which on-the-job training may be appropriate. The initial steps leading to the development of curricula involve the identification and listing of all possible tasks in a specified functional area, and verification of their performance by personnel in the occupational categories under consideration. The report deals with the results of a survey of task performance in the medical laboratory field, one of several clinical services for which the development of curricula is envisioned.

It is generally recognized that there is an insufficient supply of skilled manpower in most parts of the country today to provide quality clinical laboratory service. The technological revolution in clinical laboratory practice in recent years has made continuing education a vital necessity to enable laboratory personnel to stay abreast of their profession. The present survey was conducted to assist in determining the content of an educational curriculum for laboratory workers. It was necessary to ascertain (a) which laboratory tasks were performed by a large percentage of laboratory personnel and (b) what classification of personnel (i.e., certified/non-certified) was performing them.

II. PROCEDURE

A. Survey Instruments

Data on institutional practices in the medical laboratory field were collected by means of a survey form listing those specific tasks which might be performed by individuals who participate in medical laboratory procedures. After a survey of pertinent literature, a tentative list of tasks was constructed. This list was reviewed by the National Technical Advisory Committee for Medical Laboratory Occupations at its July 1969 meeting.[1] Revisions and additions were made by the Committee, and the list as approved

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[1] Meeting Report, National Technical Advisory Committee for Medical Laboratory Occupations, Martin B. Ross, (Mary Ellison, ed.), Los Angeles, California, July 25-26, 1969, Allied Health Professions Projects, University of California, Los Angeles, 1969.

for the survey consisted of 530 tasks grouped under two main headings (Laboratory Functions and Management Functions) and 20 sub-headings. The survey form (see sample in Appendix M) provided for responses on three dimensions of performance for each task: Check if done; Frequency; How difficult is this task? Ordinal scales of five steps each were provided for responses on the frequency and difficulty dimensions, the steps being defined in the instructions to respondents (Appendix N) and on the survey form.

A pre-survey information form (see Appendix L) was sent to laboratory directors (mainly clinical pathologists) in six metropolitan areas to obtain from each laboratory a list of personnel and descriptive information concerning the laboratory facility.

In the six areas, a panel of 48 hospitals was selected for all or most of the task analyses to be performed in the Allied Health Professions Projects (AHPP). To obtain a more inclusive laboratory sample, the original facility list was expanded to include five independent laboratories, one state hospital (Camarillo State Hospital), one federal institution (Wadsworth Veterans Administration Hospital), and one additional large hospital (Memorial Hospital of Southern California, Culver City).

B. Respondents Sample

Responses to the medical laboratory survey were obtained from 224 individuals at 29 institutions,[1] of which seven were large hospitals (200 or more beds), 10 were medium-sized hospitals (100-199 beds), seven were small hospitals (fewer than 100 beds), and five were independent laboratories. Extended care facilities were to be included; none of those that we contacted, however, had its own laboratory facilities. The number of respondents varied from one facility to another, from a minimum of one to a maximum of 35. The occupational categories represented in the respondent sample were varied. Representative classifications of certifications included: microbiologist; Medical Technologist (MT), American Society of Clinical Pathologists (ASCP); Clinical Laboratory Technologist, California registry; medical technician; Medical Laboratory Technician, MLT(ASCP); Certified Laboratory Assistant, CLA(ASCP); lab helper; biochemist; health aide; biologist (research); autopsy assistant; lab assistant; Cytotechnologist, CT(ASCP); Histologic Technician, HT(ASCP); Bioanalyst, California registry; and others. The background data for the respondents are shown in Appendix A. The majority of respondents work in large non-profit hospitals located in the Midwest or West.

Most of the respondents are married females, 40 years old or less. They are well educated, as the mean years of school completed is 14 and the majority hold a bachelor's degree or higher.

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[1]Designated by asterisk in the list of 57 institutions selected for National Sample of Health Care Facilities (Appendix P).

C. Data Analysis

Assistance in processing and reduction of survey and background information data and in computer analysis of these data was provided by the Survey Research Center of the University of California, Los Angeles. Frequency distributions were obtained for responses to the questions on frequency and difficulty of task performance for all tasks listed on the survey for each of the respondents.

The most important aspect of performance was considered to be whether or not a task was performed at all by the respondents. (Most tasks performed by a high percentage of respondents were performed frequently, and those with a low percentage of persons performing were performed infrequently.) Therefore, frequency is discussed only when it deviates from this generalization or when it is important to the topic under consideration.

Task difficulty data are not included in the present report because analysis indicated that there were no important differences among the different groups of respondents with respect to the difficulty of a task.

The respondents were grouped as certified or non-certified. Certified respondents are those who hold one or both of the following certifications:

- Medical Technologist, American Society of Clinical Pathologists

- Clinical Laboratory Technologist, California registered

The non-certified group includes those respondents who hold no certification. The background data of the two groups were analyzed and the highest percentage performance of tasks by the certified group was compared with the percentage performance by the non-certified group on the same tasks.

The respondents in the two groups were further sub-divided into two classifications--Specialists and Generalists--according to their major responsibilities in a clinical area. A clinical area is any one of the laboratory departments--Bacteriology, Biochemistry, Blood Bank, Hematology, Serology, Urinalysis, Cytotechnology, and Histology. A respondent is classified as a specialist if he selected/reported this area as his major responsibility in the personal data part of the survey questionnaire and did <u>not</u> report more than one other area. A respondent is classified as a generalist if he selected/reported <u>more</u> than two clinical areas as his major responsibilities or if he indicated the choice "general" on the survey questionnaire.

The four classifications that result from the new sub-divisions are certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG). Frequency

distributions were obtained in each of the clinical areas for tasks performed by the four classifications of respondents with a major responsibility in that area. The performance similarities and differences among these respondents were tabulated.

The results of the analysis are described in the present report in terms of percentage of respondents who perform the task and the rank order of performance by respondents for a group of tasks.

III. PERCENTAGE OF RESPONDENTS PERFORMING TASKS

Of the 530 laboratory and management tasks listed in the questionnaire, 52 (10%) were performed by 50 percent* or more of the 224 respondents. Table 1 lists general tasks performed by the 50 percent or more of the survey respondents. (General tasks are those laboratory and management tasks which are performed in most laboratory departments or clinical areas.) The majority of these tasks can be grouped into the following categories: (a) processing specimens, (b) maintaining materials and equipment, and (c) using standard laboratory equipment.

Laboratory tasks within a clinical area, performed by 50 percent or more of the respondents, are listed in Table 2. The Hematology area tasks are chiefly those which comprise part of (or relate to) the complete blood count (CBC). In the Urinalysis area, the work includes routine urinalysis such as color, appearance, pH, and specific gravity; biochemical tests; and microscopic analysis. The Microbiology area tasks involve streaking and incubating plates. In the Biochemistry area, there are 14 tasks relating to enzyme, kidney function, electrolyte, and liver function procedures.

A review of the survey results reveals that there are no tasks performed by 50 percent or more of the respondents from the Blood Bank, Serology, Histology, or Cytotechnology clinical areas. Appendix Q lists the percent performance on all survey tasks.

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*Because laboratory workers employed in many types of facilities form a diverse group with many different certifications and specialties, a task that has a 50 percent or higher performance by all the respondents or by a certain classification of respondent was considered to be a commonly performed task and worthy of comment.

TABLE 1

GENERAL TASKS PERFORMED BY 50 PERCENT OR MORE OF RESPONDENTS

TASK CATEGORY	TASK	RESPONDENT PERCENT (n=224)
GENERAL MEDICAL LABORATORY		
Maintain materials and equipment	Clean area and equipment aseptically	53
	Inventory and order supplies	64
Collect and process specimens	Collect blood specimens from patients	67
	Prepare and process specimens	64
	Prepare specimens for shipment	51
Prepare materials	Prepare reagents	78
	Prepare standards	61
Communicate with others	Communicate findings to physicians	67
Operate and use laboratory equipment	Operate analytical balance	64
	Operate spectrophotometer	50
	Use centrifuge	89
	Use microscope - light bright field	72
	Use pipette	
	Automatic	51
	Manual	86
	Macro - 0.1 ml. or larger	80
	Micro - less than 0.1 ml.	65
	To deliver	79
	To contain	71
	Use water baths	76

TABLE 2

LABORATORY AREA TASKS PERFORMED BY 50 PERCENT OR MORE OF RESPONDENTS

TASK CATEGORY	TASK	RESPONDENT PERCENT (n=224)
HEMATOLOGY CLINICAL AREA		
Cell counts, morphology, and related tests	Perform differential cell counts	54
	Perform red blood count	53
	Perform white blood count	57
	Perform platelet count	52
	Perform spinal fluid cell counts	50
	Identify morphological variations of red or white blood cells	51
	Perform hematocrit tests	58
	Perform hemoglobin tests	59
	Perform erythrocyte sedimentation rate	54
Clotting tests	Perform venous whole blood coagulation time tests	50
	Perform prothrombin time test	53
Laboratory equipment	Operate microhematocrit centrifuge	57
	Operate microhematocrit reader	51
URINALYSIS CLINICAL AREA		
Urine character	Examine urine specimens macroscopically	60
Biochemical tests	Perform acetone or ketone tests	57
	Perform bile tests	51
	Perform true glucose tests	50
	Perform qualitative urine protein tests	53
Other tests	Perform specific gravity tests	60
	Perform pH tests	57
	Examine urine specimens microscopically	58
MICROBIOLOGY CLINICAL AREA		
Culture set-ups	Streak plates	52
Laboratory equipment	Use incubator, aerobic	50

TABLE 2

(Continued)

LABORATORY AREA TASKS PERFORMED BY 50 PERCENT OR MORE OF RESPONDENTS

TASK CATEGORY	TASK	RESPONDENT PERCENT (n=224)
BIOCHEMISTRY CLINICAL AREA		
Enzyme tests	Perform acid phosphatase test	50
	Perform alkaline phosphatase test	53
	Perform amylase test	55
	Perform serum glutamic oxalacetic transaminase (SGOT) test	53
	Perform lactic dehydrogenase (LDH) tests	52
Electrolyte tests	Perform chlorides tests	51
	Perform potassium determinations	53
	Perform sodium determinations	50
Liver functions tests	Perform bilirubin (direct) test	56
	Perform bilirubin (indirect) test	55
Kidney function and other tests	Perform serum creatinine tests	50
	Perform glucose tests	56
	Perform glucose tolerance tests	50
	Perform blood urea nitrogen (BUN) tests	52

IV. GROUPING BY CERTIFICATION

A. DEFINITION OF GROUPS

1. Certified

This group is limited to the respondents who indicated in the personal data section of the survey questionnaire that they were certified as at least one of the following:

- MT (ASCP) Medical Technologist, American Society of Clinical Pathologists

- CLT (Calif.) Clinical Laboratory Technologist, California registered

The reason for limiting the certified group to these two certifications is that significant numbers of respondents held them. Of the 224 respondents, 107 or almost 50 percent were certified MT(ASCP), CLT (Calif.) or both. Another reason for including these two certifications is that their educational requirements are similar. For both at least three years are needed of college and clinical training in an approved laboratory. Table 3, Education and Training, shows that the certified group has a homogeneous educational background, inasmuch as 90 percent of them have completed 15 or more years of school and 91 percent have at least a baccalaureate degree.

Failure to include other certifications performing laboratory tests (see Appendix C) does not imply that those respondents are less qualified than the two groups selected.

2. Non-certified

This group includes the 79 respondents who indicated "none" in response to "the type of certification," as well as those who wrote a non-certified laboratory occupational title, e.g., laboratory aide, in the personal data section of the survey questionnaire. None of the "other certifications or specialists," which are listed in Appendix B, is included in this group.

B. CERTIFIED/NON-CERTIFIED BACKGROUND DATA

The background data of the certified and non-certified groups are summarized in Appendix B. The majority of both certified and non-certified groups are like the total respondent sample--married females under 40 years of age, employed in large non-profit hospitals.

The major difference between the two groups is in education-related background. For 60 percent of the non-certified and only 14 percent of the certified group the high school diploma is the highest "degree" obtained. Ninety-one percent of the certified as compared to 32 percent of the non-certified group have obtained a baccalaureate degree or higher.

C. PERFORMANCE OF QUESTIONNAIRE TASKS

1. Questionnaire Items

There are 530 items in the survey questionnaire, 399 of which are Laboratory Function Tasks and 131 Management Function Tasks. The Laboratory Function Tasks are divided into 14 areas which represent the main laboratory departments. These areas include:

a. Performing General Medical Laboratory Tasks (33)*
b. Preparing Medical Illustration Materials (5)
c. Utilizing Laboratory Equipment (100)
d. Performing Bacteriological Procedures (19)
e. Performing Mycology Procedures (6)
f. Performing Parasitology Procedures (9)
g. Performing Serology Procedures (26)
h. Performing Hematology Procedures (33)
i. Performing Urinalysis Procedures (24)
j. Performing Radioactivity Detection Procedures (10)
k. Performing Biochemistry Procedures (61)
l. Performing Histology Procedures (19)
m. Performing Blood Banking Procedures (35)
n. Performing Cytotechnology Procedures (19)

2. Tasks Performed by Largest Percentage of Certified Technologists

Table 3 lists the ten tasks out of 599 performed by the highest percentage of certified technologists. They are the only tasks performed by 80 percent or more of this group. All ten tasks are in two areas:

a. Performing General Medical Laboratory Tasks
b. Utilizing Laboratory Equipment

The results are not unexpected, inasmuch as pipettes, centrifuges, and water baths are standard equipment. Also, Preparing reagents and standards, Collecting blood, Taking inventory and ordering supplies are tasks performed in all laboratory departments and facilities.

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*Numbers in parentheses are questionnaire items (see Appendix Q).

TABLE 3

TEN LABORATORY FUNCTION TASKS PERFORMED BY THE LARGEST PERCENTAGE OF CERTIFIED TECHNOLOGISTS

Laboratory Function	Certified Rank Order (599 tasks)	Non-Cert. Rank Order (599 tasks)	Certified Percent (n=107)	Non-Cert. Percent (n=79)	p** (less than)
Use pipette (manual)	1	2	94	81	.05
Use centrifuge (general)	2	1	94	85	.05
Use pipette (macro 0.1 ml. or larger)	3	5	92	71	.01
Use pipette (to deliver)	4	4	91	75	.05
Collect blood specimens	5.5*	11	87	56	.001
Prepare reagents	5.5*	7	87	66	.01
Use pipette (to contain	7	9	85	62	.01
Use water baths	8	3	83	75	
Prepare standards	9	29	81	43	.001
Inventory and order supplies	10	18	80	48	.001

*same rank order.

**level of significance for Chi Square (df=3) was based on both differences in percent and frequency of performance of tasks by the certified and non-certified categories.

The first seven tasks are performed by a greater percentage of certified than non-certified respondents. It should be noted that the task, Prepare standards, is somewhat ambiguous because it could have been interpreted as meaning either to prepare stock standards or to dilute commercial standards.

Each of the ten tasks performed by the largest percentage of non-certified personnel is listed in Table 3 except for the following: the sixth-ranked task, Using microscopes (performed by 67% of non-certified and 79% of certified); the eighth-ranked task, Prepare and process specimens (performed by 62% of non-certified and 65% of certified); and the tenth-ranked task, Clean area and equipment aseptically (performed by 57% of non-certified and 50% of certified).

D. PERFORMANCE OF CLINICAL PROCEDURES

The questionnaire section on Clinical Areas includes Procedures in Bacteriology, Mycology, Parasitology, Serology, Hematology, Urinalysis, Radioactivity Detection, Biochemistry, Histology, Cytotechnology, and Blood Banking.

In these areas there was a marked difference between the percentages of certified and non-certified respondents who performed the procedures, as well as the frequency of performance. Among the 261 procedures in the clinical areas, 92 (35%) were performed by half or more of the certified technologists. Only one (0.4%), Streak plates, in Bacteriology, was performed by half or more of the non-certified workers.

Table 4 shows the ten clinical procedures performed by the largest percentage of certified technologists. All of these procedures are included in three classes: routine complete blood count, routine urinalysis and two routine chemistry tests (bilirubin and glucose).

On the average, 30 percent more certified than non-certified personnel perform the above procedures. This is important because the percentages for both respondent groups indicating Hematology and Urinalysis as their major responsibilities are almost the same (see Appendix B, Table B4).

1. Rank Order

The rank order is the sequence in which a group of tasks or procedures is performed by a percentage of respondents belonging to a certain category, with Rank 1 being the highest percentage.

The order of the ten procedures shown in Table 4 contrasts the two groups--certified and non-certified. The Differential cell count procedure, a Hematology area test, reveals the largest difference between the two groups. It is the eighth-ranked task for the certified group and the 21st ranked for the non-certified group.

TABLE 4

TEN CLINICAL PROCEDURES PERFORMED BY THE LARGEST PERCENTAGE OF CERTIFIED TECHNOLOGISTS

(261 Clinical Procedures)

Laboratory Function	Certified Rank Order (599 tasks)	Non-Cert. Rank Order (599 tasks)	Certified Percent (n=107)	Non-Cert. Percent (n=79)	p** (less than)
Perform hematocrit tests	1	10	78	44	.001
Perform hemoglobin tests	2	7	78	46	.001
Perform white blood counts	3	12	77	43	.001
Examine urine specimens macroscopically	4	4	77	46	.001
Examine urine specimens microscopically	5	5	77	46	.001
Prepare and stain blood smears	6	8	76	46	.001
Perform specific gravity tests	7	2	76	48	.001
Perform differential cell counts	8	21	75	38	.001
Perform bilirubin (direct) tests	9	38	75	34	.001
Perform glucose tests	10	18	74	39	.001

**level of significance has the same basis as Table 3.

The rank order differences between the bilirubin and glucose tests could be partially explained by the greater number of certified (39%) than non-certified (27%) whose major responsibility is Biochemistry.

These results are not in agreement with a study made by Ammer.[1] He found that there was no significant difference between the quantitative working patterns of technicians and technologists. His technologist group included some with baccalaureate degrees who had no ASCP certification. Since such an individual is classified in this report's "non-certified" category, the different findings are more significant. He compared these categories of workers within a single facility. This is not the case when personnel from different types of laboratories and different facilities are compared.

2. Rank Order in Clinical Areas

In the preceding sections, differences among the groups were apparent in the total percentage performing the procedures. Differences were also noted when rank order comparisons were made on individual tasks.

Coefficients of correlation for all the tasks in eight clinical areas were calculated to determine the rank order of the performance percentages of certified and non-certified personnel (see Table 5). In all areas except for Mycology the coefficient of correlation is high, .60 or greater, which indicates that in those areas the rank order of percentage performance is almost the same for the two groups. This means that the tasks performed by the largest percentage of certified technologists are also performed by the largest percentage of non-certified workers.

The low coefficient of correlation in Mycology is caused by a different rank in percent performance on two tasks by certified and non-certified workers. Cultivating mycology specimens for primary isolation is ranked first for certified workers and third for non-certified personnel. Preparing culture media is ranked last by certified and first for non-certified personnel.

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[1] Ammer, Dean S., Productivity, Personnel, and Problems of Hospital Clinical Laboratories, Northeastern University, Boston, Mass., 1969.

TABLE 5

COMPARISON OF PERCENT PERFORMANCE OF TASKS BY CERTIFIED AND NON-CERTIFIED PERSONNEL

Clinical Area	Spearman Rank Order Coefficient of Correlation
Biochemistry (61 tasks)	.91
Blood Bank (35 tasks)	.76
Cytotechnology (19 tasks)	.60
Hematology (33 tasks)	.93
Histology (19 tasks)	.76
Microbiology	
- Bacteriology (19 tasks)	.93
- Mycology (6 tasks)	.11
- Parasitology (9 tasks)	.94
Serology (26 tasks)	.89
Urinalysis (24 tasks)	.95

All correlations are significant at the .01 level of confidence except for Mycology, with a level of confidence greater than .05.

V. GROUPING BY GENERALIST/SPECIALIST

A. DEFINITION OF CATEGORIES

1. Generalist

A respondent is classified as a generalist if he made either of the following choices in the personal data part of the survey questionnaire:

a. If he circled more than two clinical areas as his major responsibilities--Bacteriology, Biochemistry, Blood Bank, Hematology, Serology, Urinalysis, Cytotechnology, and Histology.

b. If he indicated the choice "general" (rotate continuously through any five of the above).

2. Specialist

A respondent is classified as a specialist in one of the above clinical areas (see 1a above) if he named this area as his major responsibility in the personal data part of the survey questionnaire and not more than one other area. Table 6 lists the number of respondents who are generalists and specialists in each clinical area.

B. SUB-GROUPING OF THE GENERALIST/SPECIALIST CATEGORIES

1. The specialist and generalist categories were grouped into certified and non-certified classifications as previously defined (see Section III).

2. The four classifications that will be analyzed are: Certified Specialist (CS); Non-certified Specialist (NCS); Certified Generalist (CG); and Non-certified Generalist (NCG).

C. ANALYSIS OF THE CLINICAL AREAS THAT IDENTIFY THE SPECIALISTS AND ARE THE MAJOR RESPONSIBILITIES OF THE GENERALISTS

1. Generalists

The rank order of the total number of generalist respondents (both certified and non-certified) according to their major responsibilities is shown in Table 7. Urinalysis, Hematology, and Biochemistry (16%, 16% and 14% of the respondents respectively) are at the top and Histology (1.5%) and Cytotechnology (1.5%) are last.

The rank order of certified generalists and non-certified generalists was either the same or differed by one rank.

TABLE 6

DISTRIBUTION OF RESPONDENTS CLASSIFIED ACCORDING TO GENERALISTS/SPECIALISTS

RESPONDENTS		
Group	Number	** Percent (n=215)
Generalists	* 78	36
Specialists	137	64
Bacteriology	16	7
Biochemistry	41	19
Blood Bank	7	4
Hematology	15	7
Serology	8	4
Urinalysis	16	7
Cytotechnology	16	7
Histology	18	8

* Forty-nine of these indicated "general" as their major responsibility.

** Total percent is greater than 100 since each respondent may be placed in two specialist groups.

2. Specialists

The rank order of the total number of specialist respondents (both certified and non-certified) in specialty areas is also shown in Table 7. Biochemistry (10%) is followed by Bacteriology (6%) and Urinalysis (6%). The last three are Cytotechnology (4%), Serology (3%), and Blood Bank (3%). In contrast with the generalist's clinical area of major responsibility, Bacteriology appears to be a specialty area (specialists rank it second compared to generalists' rank or sixth). Surprisingly, Blood Bank is not a specialty area.

The widest differences in the rank orders of certified and non-certified specialists are in Histology and Hematology. For the non-certified specialists, the rank of major responsibility in Histology is a first place tie with Biochemistry; for the certified specialists Histology ranks last (eighth).

The non-certified specialist shows a rank of five for the Hematology clinical area in contrast to the rank of two for the certified specialist.

TABLE 7

RANK ORDER OF MAJOR RESPONSIBILITIES INDICATED BY GENERALISTS AND SPECIALISTS

MAJOR RESPONSIBILITY CLINICAL AREA	GENERALISTS (n=78)							SPECIALISTS (n=137)							TOTAL Generalists & Specialists (n=215)		
	Non-Certified			Certified			Rank Total	Non-Certified			Certified			Rank Total			
	Rank	#	%	Rank	#	%		Rank	#	%	Rank	#	%		Rank	#	%
Urinalysis	1	14	18	1.5	22	28	1	4	8	6	5	5	4	3	2	49	23
Hematology	2	13	16	1.5	22	28	2	5	6	4	2	6	4	4.5	3	47	22
Biochemistry	3	11	14	3	20	26	3	1.5	11	8	1	23	17	1	1	65	30
Bacteriology	4	8	11	6	13	17	5	3	9	7	5	5	4	2	4	35	16
Serology	5	6	8	4	17	22	4	7.5	2	1	5	5	4	7.5	5	30	14
Blood Bank	6	4	5	5	16	21	6	7.5	2	1	5	5	4	7.5	6	27	13
Histology	7	3	4	7.5	1	13	7	1.5	11	8	8	1	1	4.5	7	16	7
Cytotechnology	8	2	3	7.5	1	13	8	6	4	3	[illegible]	5	4	6	8	12	6

= Number responding

VI. PERFORMANCE OF SPECIALTY AREA TASKS BY AREA SPECIALISTS AND GENERALISTS

INTRODUCTION

An analysis was made of the performance of tasks in the various clinical areas by the specialists and the generalists who indicated one or more areas of major responsibility. Four classifications of personnel were analyzed: (1) certified generalist (CG); (2) non-certified generalist (NCG); certified specialist (CS); and (4) non-certified specialist (NCS).

Tabulation of similarities among classifications was made when all classifications had a performance of 50 percent or more or when all classifications had a performance of 25 percent or less.

Tabulation of differences among classifications was made when the performance of one classification was 50 percent or more and the performance of another classification was 25 percent or less.

A. SPECIALTY AREA: BACTERIOLOGY*

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Bacteriology Certified Specialist (CS)	5	14	2
Bacteriology Non-certified Specialist (NCS)	9	26	4
Bacteriology Certified Generalist (CG)	13	37	6
Bacteriology Non-certified Generalist (NCG)	8	23	4
TOTALS	35	100	16

*Mycology and Parasitology tasks are included in this area which might have been designated as Microbiology.

The percentage of respondents with a major responsibility in the Bacteriology clinical area is one and one-half times greater for generalists (60%) than for specialists (40%). The percentage of certified personnel is more than twice as great for generalists:

-74 percent of generalists
-35 percent of specialists
-51 percent of the total clinical area

1. Performance Similarities Among Classifications

Appendix D lists 34 tasks performed in the Microbiology clinical area (19 in Bacteriology, six in Mycology, and nine in Parasitology). Six of the tasks (18%), all in the Bacteriology clinical area, are performed by 50 percent or more of the respondents (see Table 8). Most of these tasks can be grouped under two headings:

Staining bacteriology smears
Inoculating media

Fifty percent or more of all classifications perform no mycology or parasitology tasks.

The task, Maintain parasite cultures, is performed by less than 25 percent of all classifications (see Table 9).

TABLE 8

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN MICROBIOLOGY PROCEDURES

SUB-GROUP 1: Fifty percent or more performance by all classifications. Rank in descending order by task for: certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

MICROBIOLOGY CLINICAL AREA TASKS*	CLASSIFICATION			
	%CS (n=5)	%NCS (n=9)	%CG (n=13)	%NCG (n=8)
B - Streak plates.	100	100	100	88
B - Stain bacteriological smears.	100	89	100	75
B - Inoculate tubed media.	100	89	92	62
B - Examine specimens microscopically.	100	78	100	62
B - Receive and primary process all cultures except blood, T.B., and fungus.	80	78	92	62
B - Receive and process blood cultures.	80	67	100	62

* B = Bacteriology

TABLE 9

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN MICROBIOLOGY PROCEDURES

SUB-GROUP 2: Twenty-five percent or less performance by all classifications for: certified generalist (CG), non-certified generalist (NCG), certified specialist (CS), and non-certified specialist (NCS).

MICROBIOLOGY CLINICAL AREA TASK*	CLASSIFICATION			
	%CS (n=5)	%NCS (n=9)	%CG (n=13)	%NCG (n=8)
P - Maintain parasite cultures.	20	0	23	12

* P = Parasitology

2. Performance Differences Among Classifications

The more sophisticated tasks of identifying and classifying bacteria (Table 10) have a low percentage performance by the non-certified generalist classification.

Similarly, this non-certified generalist group tends neither to stain nor inoculate tuberculosis, mycology, and parasitology specimens.

TABLE 10

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN MICROBIOLOGY PROCEDURES

SUB-GROUP 1: Certified specialist (CS), non-certified specialist (NCS), and certified generalist (CG) with 50 percent or more performing tasks; non-certified generalist (NCG) with 25 percent or less performing tasks.

MICROBIOLOGY CLINICAL AREA TASKS*	CLASSIFICATION			
	%CS (n=5)	%NCS (n=9)	%CG (n=13)	%NCG (n=8)
B - Identify and classify pathogenic bacteria.	100	78	100	25
B - Receive and process T.B. cultures.	80	67	77	25
B - Maintain stock cultures.	80	78	54	12
B - Operate anaerobic devices.	100	78	85	12
M - Cultivate mycology specimens for primary isolation.	100	67	92	12
M - Examine mycology specimens microscopically.	100	56	77	12
M - Stain mycology specimens.	100	56	62	12
P - Examine parasite specimens macroscopically.	80	56	77	12
P - Perform concentration and flotation techniques.	80	67	85	12
P - Stain parasitological smears.	60	56	69	12

* B = Bacteriology M = Mycology P = Parasitology

Only the two certified classifications show a 50 percent or greater performance in identifying and classifying mycology and parasitology organisms (Table 11).

TABLE 11

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN MICROBIOLOGY PROCEDURES

SUB-GROUP 2: Certified Tasks

Certified specialist (CS) and certified generalist (CG) with 50 percent or more performing tasks; non-certified generalist with 25 percent or less performing tasks.

MICROBIOLOGY CLINICAL AREA TASKS*	CLASSIFICATION			
	%CS (n=5)	%NCS (n=9)	%CG (n=13)	%NCG (n=8)
P - Identify protozoans, cestodes, nematodes, and trematodes.	80	44	85	12
M - Identify and classify fungi.	80	44	69	12
M - Perform KOH preparations for dermatophytes	80	44	69	12
P - Identify parasitic and disease carrying arthropods.	60	36	62	12
B - Record and/or report colony counts on other than urine.	60	22	69	25

* B = Bacteriology M = Mycology P = Parasitology

Only the two specialist classifications prepare mycology culture media (Table 12).

TABLE 12

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN MICROBIOLOGY PROCEDURES

SUB-GROUP 3: Specialist Tasks

Certified specialist (CS) and non-certified specialist (NCS) with 50 percent or more performing tasks; non-certified generalist (NCG) with 25 percent or less performing tasks.

MICROBIOLOGY CLINICAL AREA TASK*	CLASSIFICATION			
	%CS (n=5)	%NCS (n=9)	%CG (n=13)	%NCG (n=8)
M - Prepare mycology culture media.	80	89	(46)	25

* M = Mycology

Only the certified specialist classification has a 50 percent or greater performance on Performing microfilarial examination (Table 13).

TABLE 13

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN MICROBIOLOGY PROCEDURES

SUB-GROUP 4: Certified Specialist Tasks

Certified specialist (CS) with 50 percent or more performing tasks; non-certified specialist (NCS) and non-certified generalist (NCG) with 25 percent or less performing tasks; and certified generalist (CG) with 26 percent to 49 percent performing tasks.

MICROBIOLOGY CLINICAL AREA TASK*	CLASSIFICATION			
	%CS (n=5)	%NCS (n=9)	%CG (n=13)	%NCG (n=8)
P - Perform microfilarial examination.	60	11	46	12

* P = Parasitology

B. SPECIALTY AREA: SEROLOGY

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Serology Certified Specialist (CS)	5	17	2
Serology Non-certified Specialist (NCS)	2	7	1
Serology Certified Generalist (CG)	17	56	8
Serology Non-certified Generalist (NCG)	6	20	3
TOTAL	30	100	14

The highest percentage of respondents (76%) whose major responsibility is the Serology clinical area are generalists. Seventy-four percent of the generalists, 71 percent of the specialists, and 73 percent of the total Serology clinical area are certified.

1. Performance Similarities Among Classifications

Appendix E lists the 26 tasks in the Serology clinical area of the questionnaire.

Table 14 lists the six tasks which comprise 23 percent of total tasks performed by 50 percent or more of all classifications. Table 15 lists the four tasks which comprise 15 percent of the total tasks with 25 percent or less performance percentage.

2. Performance Differences Among Classifications

The one task that shows a 50 percent or more performance in one classification and 25 percent or less performance in another is: Perform and read precipitation reactions (e.g., agar gel immunodiffusion). The performance percentages are: certified specialist (60%), non-certified specialist (0%), certified generalist (18%), and non-certified generalist (17%). This appears to be a certified specialist task.

TABLE 14

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN SEROLOGY PROCEDURES

SUB-GROUP 1: Fifty percent or more performance by all classifications; rank in descending order by task for: Certified generalist (CG), non-certified generalist (NCG), certified specialist (CS), and non-certified specialist (NCS).

SEROLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=2)	%CG (n=17)	%NCG (n=6)
Perform rheumatoid arthritis test (RA).	80	100	71	83
Perform latex fixation test.	80	100	76	50
Perform heterophile presumptive test.	60	100	71	67
Perform infectious mononucleosis procedures - monospot or monotest.	60	100	88	50
Perform and read agglutination tests (e.g., cold agglutinations).	60	50	76	50
Perform antistreptolysin "O" titers.	60	100	71	67

TABLE 15

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN SEROLOGY PROCEDURES

SUB-GROUP 2: Twenty-five percent or less performance by all classifications; rank in ascending order by task for: Certified generalist (CG), non-certified generalist (NCG), certified specialist (CS), and non-certified specialist (NCS).

SEROLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=9)	%CG (n=13)	%NCG (n=8)
Prepare specimens for virus isolation.	0	0	12	0
Identify viruses and/or rickettsia.	0	0	18	0
Perform strep MG test.	0	0	18	0
Perform fluorescent treponemal antibody test.	20	0	18	0

C. SPECIALTY AREA: HEMATOLOGY

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Hematology Certified Specialist (CS)	6	13	3
Hematology Non-certified Specialist (NCS)	6	13	3
Hematology Certified Generalist (CG)	22	47	10
Hematology Non-certified Generalist (NCG)	13	27	6
TOTAL	47	100	22

The majority of respondents (74%) whose major responsibility is the Hematology clinical area are generalists. Sixty-three percent of the generalists, half (50%) of the specialists, and 60 percent of the total Hematology clinical area are certified.

1. Performance Similarities Among Classifications

Appendix F lists 33 tasks in the Hematology clinical area. Of these, over half (18) are quantitatively performed by 50 percent or more of all the four Hematology classifications. Included in this group (Table 16) are the routine Hematology procedures relating to the complete blood count (hemoglobin, hematocrit, white blood cell count, red blood cell count, differential cell count, platelet count, reticulocyte count, sedimentation rate, and erythrocyte indices); preparation of slides (differential smear and L.E. slide); coagulation studies (bleeding time, prothrombin time tests, and clot retraction tests).

TABLE 16

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN HEMATOLOGY PROCEDURES

SUB-GROUP 1: Fifty percent or more performance by all classifications. Rank in descending order by task for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

HEMATOLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=6)	%NCS (n=6)	%CG (n=22)	%NCG (n=13)
Perform hematocrit tests.	100	83	96	100
Perform hemoglobin tests.	100	83	96	100
Perform white blood count.	100	83	96	92
Prepare and stain blood smears.	100	83	96	85
Perform erythrocyte sedimentation rate.	100	83	96	85
Perform platelet count.	100	67	91	85
Perform differential cell counts.	100	67	96	77
Perform red blood count.	100	67	96	77
Perform prothrombin time test.	100	67	91	77
Identify morphological variations of red or white blood cells.	100	50	96	77
Calculate erythrocyte indices.	100	83	77	62
Perform clot retraction test.	100	67	86	62
Perform venous whole blood coagulation time tests.	67	83	91	69
Perform bleeding time procedures.	67	83	96	62
Prepare lupus erythematosus (L.E.) slides.	100	67	86	54
Perform reticulocyte cell count.	100	50	91	62
Perform partial thromboplastin time (PTT) test.	67	67	91	62
Perform eosinophile count.	83	59	73	54

The only task in which the performance of all four classifications was less than 25 percent is "Perform chromosomal analysis" (Table 17).

TABLE 17

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN HEMATOLOGY PROCEDURES

SUB-GROUP 2: Twenty-five percent or less performance by all classifications for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

HEMATOLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=6)	%NCS (n=6)	%CG (n=22)	%NCG (n=13)
Perform chromosomal analysis.	0	0	9	0

2. Performance Differences Among Classifications

The six tasks in which the percentage performance among classifications shows a large difference are listed in Tables 18 through 20.

None of these tasks is considered a routine Hematology task. Four of them test deficiencies in the body's clotting mechanism: the fibrinogen deficiency, fibrinolysin, prothrombin consumptions, and factors V-VIII-X. Some of them are performed in the Biochemistry or Blood Bank clinical areas. The blood dyscrasia tests, sickle cell, and peroxidase tests are specialized procedures.

TABLE 18

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN HEMATOLOGY PROCEDURES

SUB-GROUP 1: Certified specialist (CS), certified generalist (CG), and non-certified generalist (NCG) with 50 percent or more performing tasks; non-certified specialist (NCS) with 25 percent or less performing tasks.

HEMATOLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=6)	%NCS (n=6)	%CG (n=22)	%NCG (n=13)
Perform fibrinogen deficiency test.	67	17	50	54

TABLE 19

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN HEMATOLOGY PROCEDURES

SUB-GROUP 2: Certified Tasks

Certified specialist (CS) and certified generalist (CG) with 50 percent or more performing tasks; non-certified specialist (NCS) and non-certified generalist (NCG) with 25 percent or less performing tasks.

HEMATOLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=6)	%NCS (n=6)	%CG (n=22)	%NCG (n=13)
Perform fibrinolysin test.	83	17	50	8
Perform prothrombin consumption test.	50	17	59	15
Perform sickle cell preparations.	100	0	82	38

The major difference in task performance among the four classifications is that in all six tasks the non-certified specialist classification has a performance percentage of 25 percent or less, and the non-certified generalist group has a performance percentage of 25 percent or less on half (4) of the tasks and only a 38 percent performance on another.

This could mean that the tasks in the sub-group (fibrinolysin, prothrombin consumption, and sickle cell preparation) are performed primarily by certified technologists (Table 19).

The more specialized tasks in sub-group 3 (Factor V-VIII-X assays, and Stain and read peroxidase stain) are performed mainly by certified technologist specialists (Table 20).

TABLE 20

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN HEMATOLOGY PROCEDURES

SUB-GROUP 3: Certified Specialist Tasks

Certified specialist (CS) with 50 percent or more performing tasks; non-certified specialist (NCS) and non-certified generalist (NCG) with 25 percent or less performing tasks.

HEMATOLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=6)	%NCS (n=6)	%CG (n=22)	%NCG (n=13)
Perform factor V-VIII-X assays.	50	0	36	15
Stain and read peroxidase stain.	67	17	41	8

D. SPECIALTY AREA: URINALYSIS

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Urinalysis Certified Specialist (CS)	5	10	2
Urinalysis Non-certified Specialist (NCS)	8	16	4
Urinalysis Certified Generalist (CG)	22	45	10
Urinalysis Non-certified Generalist (NCG)	14	29	6
TOTAL	49	100	22

As in the Serology and Hematology areas, most respondents whose major responsibility is the Urinalysis clinical area are generalists (74%). Sixty-one percent of the generalists are certified, but only 38 percent of the Urinalysis specialists are certified; 55 percent of the entire Urinalysis specialty area are certified.

1. Performance Similarities Among Classifications

Appendix G lists 24 tasks in the Urinalysis clinical area. Of these, nine are quantitatively performed by 50 percent or more of the four urinalysis classifications. All except the Bence-Jones protein test are procedures which are part of the routine urinalysis (see Table 21).

Two highly specialized tasks (Pitressin response concentration and Water loading tests) are performed by 25 percent or less of the four classifications (see Table 22).

Three other specialized tests are performed by less than 50 percent of all classifications. They are:

-Perform toxicological tests
-Perform hemosiderin tests
-Perform phenylpyruvic acid tests

TABLE 21

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN URINALYSIS PROCEDURES

SUB-GROUP 1: Fifty percent or more performance by all classifications. Rank in descending order by task for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

URINALYSIS CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=8)	%CG (n=22)	%NCG (n=14)
Perform bile tests.	60	62	91	79
Perform pH tests.	60	62	91	86
Examine urine specimens macroscopically.	80	50	96	79
Perform true glucose tests.	80	50	86	79
Perform specific gravity tests.	60	50	96	86
Perform qualitative urine protein tests.	60	62	86	79
Perform urine hemoglobin (blood) test.	60	50	96	64
Perform Bence Jones protein test.	60	50	73	79

TABLE 22

SUB-GROUP 2: Twenty-five percent or less performance by all classifications; rank in ascending order by task for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

URINALYSIS CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=8)	%CG (n=22)	%NCG (n=14)
Perform pitressin response concentration test.	0	0	9	0
Perform water loading test.	0	0	9	0

2. Performance Differences Among Classifications

There is a 50 percent or greater performance by all classifications except non-certified specialists in the task Perform urobilinogen tests (Table 23). This test is often performed in the Biochemistry clinical area and would therefore be performed by Biochemistry workers or generalists from other areas. If the test is performed in the Urinalysis section, it would probably be accomplished by the certified specialist since it is not part of the routine urinalysis procedure.

TABLE 23

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN URINALYSIS PROCEDURES

SUB-GROUP 1: Certified specialist (CS), certified generalist (CG), and non-certified generalist (NCG) with 50 percent or more performing tasks; non-certified specialist (NCS) with 25 percent or less performing tasks.

URINALYSIS CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=8)	%CG (n=22)	%NCG (n=14)
Perform urobilinogen tests.	60	25	82	64

Three tasks performed by 50 percent or more of the two certified classifications are listed in Table 24. The first, Perform urine reducing substances, is part of the routine urinalysis, usually indicating the presence of glucose, a reducing substance. Perhaps the non-certified workers, with less academic background, did not recognize this test as the commonly performed "glucose" test using Clinitest$_R$ Tablets. The second task, Perform Addis counts, is one of the most difficult tests in the urinalysis area; it requires excellent technique in setting it up, expertise in microscopically identifying the cellular elements, and the ability to do quantitative calculations. The third task, Perform porphyrin tests, like the urobilinogen test, is often performed in the Biochemical laboratory department.

TABLE 24

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN URINALYSIS PROCEDURES

SUB-GROUP 2: Certified Tasks

Certified specialist (CS) and certified generalist (CG) with 50 percent or more performing tasks; non-certified specialist (NCS) with 25 percent or less performing tasks.

URINALYSIS CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=8)	%CG (n=22)	%NCG (n=14)
Perform urine reducing substance.	60	25	59	21
Perform Addis counts.	60	0	59	43
Perform porphyrin tests.	60	25	54	36

Three tasks performed by 50 percent or more of the certified specialist classification are listed in Table 25. All are highly specialized tests and on the average are performed rarely by the respondents.

TABLE 25

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN URINALYSIS PROCEDURES

SUB-GROUP 3: Certified Specialist Tasks

Certified specialist (CS) with 50 percent or more performing tasks; non-certified specialist (NCS) and non-certified generalist (NCG) with 25 percent or less performing tasks.

URINALYSIS CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=8)	%CG (n=22)	%NCG (n=14)
Perform concentration test (e.g., Fishberg).	60	12	32	21
Perform concentration dilution tests (e.g., Mosenthal).	60	0	41	7
Perform microscopic test for lipids.	60	12	36	21

E. SPECIALTY AREA: BIOCHEMISTRY (CLINICAL CHEMISTRY)

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Biochemistry Certified Specialist (CS)	23	35	11
Biochemistry Non-certified Specialist (NCS)	11	17	5
Biochemistry Certified Generalist (CG)	20	31	9
Biochemistry Non-certified Generalist (NCG)	11	17	5
TOTAL	65	100	30

As in the Bacteriology area and in contrast to the Serology, Hematology, and Urinalysis clinical areas, the percentage of respondents whose major responsibility is Biochemistry is almost equal between the generalists (48%) and specialists (52%) categories. About two-thirds of both the generalists (64%) and specialists (67%) are certified.

1. Performance Similarities Among Classifications

Appendix H lists 59 tasks in the Biochemistry clinical area. Of these, eight are quantitatively performed by 50 percent or more of the four Biochemistry classifications (see Table 26).

TABLE 26

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BIOCHEMISTRY PROCEDURES

SUB-GROUP 1: Fifty percent or more performance by all classifications. Rank in descending order by task for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

BIOCHEMISTRY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=23)	%NCS (n=11)	%CG (n=20)	%NCG (n=11)
Perform lactic dehydrogenase (LDH) tests.	78	64	75	91
Perform acid phosphatase tests.	74	64	75	91
Perform serum glutamic oxalacetic transaminase (SGOT) test.	78	64	80	73
Perform phosphorous tests.	70	46	80	82
Perform cephalin flocculations.	61	54	85	73
Perform serum glutamic pyruvic transaminase test (SGPT).	70	54	70	73
Perform thymol turbidity tests.	56	54	80	73
Perform quantitative urine chemistry tests for any of the serum or blood chemistry tests previously listed.	74	54	70	64

The "Frog test for pregnancy" (Table 27), which has proved unreliable, has been replaced in most laboratories by the commercial slide and tube antigen-antibody tests. The alkoid test is a non-routine test.

TABLE 27

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BIOCHEMISTRY PROCEDURES

SUB-GROUP 2: Twenty-five percent or less performance by all classifications. Rank in ascending order for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

BIOCHEMISTRY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=23)	%NCS (n=11)	%CG (n=20)	%NCG (n=11)
Perform acid gel reaction.	0	0	15	9
Perform frog test for pregnancy.	13	9	15	9
Perform alkaloid test.	17	9	25	0

2. Performance Differences Among Classifications

See Section VII: Discussion.

TABLE 28

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BIOCHEMISTRY PROCEDURES

SUB-GROUP 1: Certified specialist (CS), certified generalist (CG), and non-certified generalist (NCG) with 50 percent or more performing tasks; non-certified specialist (NCS) with 25 percent or less performing tasks.

BIOCHEMESTRY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=23)	%NCS (n=11)	%CG (n=20)	%NCG (n=11)
Perform glucose tolerance test.	65	18	90	73
Perform gastric analysis tests (e.g., acidity or Diagnex Blue).	56	18	80	54

TABLE 29

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BIOCHEMISTRY PROCEDURES

SUB-GROUP 2: Certified Tasks

Certified specialist (CS) and certified generalist (CG) with 50 percent or more performing tasks; non-certified generalist (NCG) with 25 percent or less performing tasks.

BIOCHEMISTRY CLINICAL AREA TASK	CLASSIFICATION			
	%CS (n=23)	%NCS (n=11)	%CG (n=20)	%NCG (n=11)
Perform barbiturate level.	52	27	65	18

TABLE 30

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BIOCHEMISTRY PROCEDURES

SUB-GROUP 3: Generalist Tasks

Certified generalist (CG) and non-certified generalist (NCG) with 50 percent or more performing tasks; and non-certified specialist (NCS) with 25 percent or less performing tasks.

BIOCHEMISTRY CLINICAL AREA TASK	CLASSIFICATION			
	%CS (n=23)	%NCS (n=11)	%CG (n=20)	%NCG (n=11)
Perform slide or tube test for pregnancy.	39	18	90	64

TABLE 31

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BIOCHEMISTRY PROCEDURES

SUB-GROUP 4: Certified Generalist Tasks

Certified generalist (CG) with 50 percent or more performing tasks; non-certified generalist (NCG with 25 percent or less performing tasks; and specialist classifications with less than 50 percent performing tasks.

BIOCHEMISTRY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=23)	%NCS (n=11)	%CG (n=20)	%NCG (n=11)
Perform colloidal gold curve tests.	17	18	60	18
Perform carbon monoxide determinations.	35	36	50	18
Perform blood alcohol tests.	26	36	50	18
Perform calculus analyses tests.	39	27	50	9
Perform xylose tolerance tests.	48	18	55	0
Perform urine porphyrin and/or porphobilinogen tests.	44	17	55	36
Perform blood oxygen tests.	35	18	50	36

F. SPECIALTY AREA: BLOOD BANKING

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Blood Bank Certified Specialist (CS)	5	18	2
Blood Bank Non-certified Specialist (NCS)	2	7	1
Blood Bank Certified Generalist (CG)	16	57	7
Blood Bank Non-certified Generalist (NCG)	5	18	2
TOTAL	28	100	12

As in the Serology, Hematology, and Urinalysis areas, the majority of respondents whose major responsibility is the Blood Bank clinical area are generalists (75%). Seventy-five percent of the generalists are certified, 71 percent of the specialists are certified, and 75 percent of the total Blood Bank clinical areas are certified.

1. Performance Similarities Among Classifications

Appendix I lists 35 tasks in the Blood Bank clinical area. Of these, 20 are quantitatively performed by 50 percent or more of the four Blood Bank classifications (see Table 32).

TABLE 32

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BLOOD BANK PROCEDURES

SUB-GROUP 1: Fifty percent or more performance by all classifications, rank in descending order by task for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

BLOOD BANK CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=2)	%CG (n=16)	%NCG (n=5)
Crossmatch blood.	100	100	94	100
Perform direct and indirect Coombs tests.	100	100	94	100
Perform antibody screen and identification tests.	100	100	88	100
Prepare and read slide agglutination reactions.	100	100	88	100
Prepare and read tube agglutination reactions.	100	100	88	100
Perform transfusion reaction studies.	100	100	69	100
Test blood for ABO grouping and ABO subgrouping.	100	100	94	60
Test blood for Rh or Du factors.	100	100	94	60
Store and/or dispose of used blood containers and pilot tubes.	100	100	50	100
Maintain blood inventory (e.g., count number of bottles on hand).	100	100	69	80
Check and record temperatures of refrigerators and/or alarms.	100	100	62	80
Perform antibody titers (dilutions).	100	100	75	60
Order blood by phone from suppliers.	100	50	81	100
Order and maintain reagents and supplies.	100	100	50	60
Process blood for packed cells.	80	100	50	80
Organize and store blood.	100	50	69	80
Perform genotype of blood.	100	50	69	80
Record information on blood record card.	100	50	69	80
Accumulate and maintain blood bank statistics.	100	50	50	75

Most of these 20 tasks are directly associated with the cross-matching of blood. These include the administrative job of assuring that sufficient units of blood are stored in a constant-temperature refrigerator as well as the tests related to determining the compatibility of the blood.

2. Performance Differences Among Classifications

Except for the certified generalists, most of the other classifications draw blood from donors (Table 33).

TABLE 33

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BLOOD BANK PROCEDURES

SUB-GROUP 1: Certified specialist (CS), non-certified specialist (NCS), and non-certified generalist (NCG) with 50 percent or more performing tasks; certified generalist (CG) with 25 percent or less performing tasks.

BLOOD BANK CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=2)	%CG (n=16)	%NCG (n=5)
Attach serial numbers to unit.	100	100	25	100
Maintain files of blood banking forms including labels.	100	50	25	60
Draw blood from donors.	80	50	25	80

Two of the five specialist tasks (Table 34) (absorption and elution techniques) involve removal of antibodies.

The three certified specialist tasks (Table 36) are all related to obtaining blood from donors.

TABLE 34

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BLOOD BANK PROCEDURES

SUB-GROUP 2: Specialist Tasks

Certified specialist (CS) and non-certified specialist (NCS) with 50 percent or more performing tasks; certified generalist (CG) and non-certified generalist (NCG) with less than 50 percent performing tasks.

BLOOD BANK CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=2)	%CG (n=16)	%NCG (n=5)
Calibrate centrifuge.	100	100	31	20
Perform absorption technique.	100	50	38	20
Perform elution technique.	100	50	44	20
Prepare special blood fractions, e.g., platelet rich blood.	80	50	19	40
Use refrigerated centrifuge.	60	50	19	20

TABLE 35

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BLOOD BANK PROCEDURES

SUB-GROUP 3: Certified specialist (CS) and non-certified generalist (NCG) with 50 percent or more performing tasks; non-certified specialist (NCS) and certified generalist (CG) with 25 percent or less performing tasks.

BLOOD BANK CLINICAL AREA TASK	CLASSIFICATION			
	%CS (n=5)	%NCS (n=2)	%CG (n=16)	%NCG (n=5)
Maintain donor files.	100	0	25	60

TABLE 36

DIFFERENCES IN PERCENT PERFORMANCE
BY RESPONDENTS IN BLOOD BANK PROCEDURES

SUB-GROUP 4: Certified Specialist Tasks

Certified specialist (CS) with 50 percent or more performing tasks; non-certified specialist (NCS) with 25 percent or less performing tasks; certified generalist (CG) and non-certified generalist (NCG) with less than 50 percent performing tasks.

BLOOD BANK CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=5)	%NCS (n=2)	%CG (n=16)	%NCG (n=5)
Screen and schedule donors.	100	0	37	40
Perform first aid for shock.	80	0	29	20
Take blood pressure of donors and/or pulse rate.	60	0	25	40

G. SPECIALTY AREA: CYTOTECHNOLOGY

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Cytotechnology Certified Specialist (CS)	5	42	2
Cytotechnology Non-certified Specialist (NCS)	4	33	2
Cytotechnology Certified Generalist (CG)	1	18	0.5
Cytotechnology Non-certified Generalist (NCG)	2	17	1
TOTAL	12	100	5.5

Appendix J lists 19 tasks in the Cytotechnology clinical area. None is performed by 50 percent or more of all classifications.

In contrast to the previous specialty areas, Cytotechnology is primarily a specialist's area. Three-fourths (75%) of respondents whose major responsibility is Cytotechnology are specialists. Fifty-six percent of the specialists and 52 percent of the generalists are certified.

H. SPECIALTY AREA: HISTOLOGY

CLASSIFICATION	RESPONDENTS		PERCENT OF TOTAL SAMPLE
	n	%	
Histology Certified Specialist (CS)	1	6	0.5
Histology Non-certified Specialist (NCS)	11	69	5
Histology Certified Generalist (CG)	1	6	0.5
Histology Non-certified Generalist (NCG)	3	19	1
TOTAL	16	100	7

Like Cytotechnology, Histology is primarily a specialist area. Three-fourths (75%) of the respondents whose major responsibility is Histology are specialists. Unlike the Cytotechnology area, only 8 percent of the specialists and 25 percent of the generalists are certified.

1. Performance Similarities Among Classifications

Appendix K lists 19 tasks in the Histology clinical area. Of these, four are quantitatively performed by 50 percent or more of the four Histology classifications (see Table 37).

TABLE 37

SIMILARITIES IN PERCENT PERFORMANCE
BY RESPONDENTS IN HISTOLOGY PROCEDURES

SUB-GROUP 1: Fifty percent or more performance by all classifications; rank in descending order by task for: Certified specialist (CS), non-certified specialist (NCS), certified generalist (CG), and non-certified generalist (NCG).

HISTOLOGY CLINICAL AREA TASKS	CLASSIFICATION			
	%CS (n=1)	%NCS (n=11)	%CG (n=1)	%NCG (n=3)
Log in and/or code incoming specimens.	100	91	100	100
Mount tissue section in preparation for microscopic study.	100	91	100	100
Stain specimens for microscopic study.	100	91	100	100
Section tissue in microscopic blocks.	100	82	100	67

VII. ANALYSIS SUMMARY

High Performance Tasks of All Respondents

The majority of respondents (Table 1, page 6, and Table 2, page 7) perform three types of general tasks:

1. Maintaining materials and equipment
2. Processing specimens
3. Using standard laboratory apparatus

Within the Laboratory department or clinical area the majority of respondents perform the following tasks:

Hematology--Most respondents perform the complete blood count. They operate related equipment, such as the microhematocrit centrifuge and reader, and perform such other tests as the sedimentation rate and simple coagulation studies.

Urinalysis--The routine urinalysis is performed by the majority of respondents. This procedure includes microscopic analysis which requires the ability to make fine discriminations among various cellular elements and artifacts.

Microbiology--Tasks are limited to preparing and incubating cultures.

Biochemistry--Tasks comprise the largest number performed by 50 percent or more of the respondents. This might be explained by the fact that the greatest percentage of respondents (33%) indicated Biochemistry as one of their major responsibilities. In addition, the method of performing tasks in this area determines to a great extent who performs the task and whether it is done as a routine task. (See discussion on Generalist/Specialist, Biochemistry area, page 55.)

Blood Bank, Serology, Cytotechnology, or Histology--No tasks are performed by a majority of the respondents. It might be concluded that the tasks in Blood Bank are critical and require either a highly trained or a specialized individual. The clinical areas of Histology and Cytotechnology are primarily specialty areas, and fewer than 10 percent of the survey respondents are specialists in either department.

Low Performance of Tasks by Respondents

A number of survey tasks had a low percentage of performance by all classifications of respondents. This could mean that such tasks are so highly specialized that few facilities (e.g., research) perform it, that the task is one rarely ordered, or that the task is obsolete. Examples of highly specialized tasks are: Maintain parasite cultures (Microbiology); Viral and Rickettsia studies (Serology); Chromosomal analyses (Hematology); Pitressin response concentration and Water loading tests (Urinalysis); and Alkaloids test (Biochemistry).

Obsolete procedures include the Frog test for pregnancy; Basal metabolism rate (BMR), performed by only 15 percent of the respondents with a frequency of "almost never," and the use of the gas sterilizer, showing a 2 percent total performance.

Low performance on tasks by one of the categories of respondents could indicate that the task requires (or is believed to require) complex knowledge and skills. Factor V-VIII-X assays, for example, are performed almost exclusively by certified respondents.

Certified/Non-certified Respondents

The performance of tasks according to certification was surveyed. The "certified group" includes Medical Technologists certified as either Clinical Laboratory Technologists (California registry) or Medical Technologists (American Society of Clinical Pathologists). The "non-certified" group includes individuals without certification of any kind.

The background data for the two groups show a number of similarities. The majority of respondents in both the certified and non-certified categories were married females under 40, who were employed in large non-profit hospitals in the Midwest and western United States. They have completed their education, mainly college/university and on-the-job training, within the last ten years.

The two groups differ in that the majority of the certified respondents completed more years of schooling and earned a greater number of bachelor's and master's degrees. For these accomplishments or because of greater responsibility, they have been compensated with higher salaries.

Six of the general laboratory tasks performed by the largest percentage of both groups require the use of laboratory equipment such as pipettes, balances, and water baths. The non-critical task, Inventory and order supplies, is performed frequently by 80 percent of certified technologists but by only 48 percent of non-certified workers. It appears that a high percentage of technologists are spending much of their time performing a relatively simple task.

For clinical area tasks, three-fourths of the certified respondents perform the Differential cell count, as compared to slightly over one-third of non-certified respondents. This might occur because the Differential test requires a higher degree of discrimination than other Hematology procedures, and is therefore assigned to the certified technologists.

When certified and non-certified respondents were compared by rank order correlation, little difference was noted (Table 5, page 15). That is, even though the percentage of performance varied for the task, there is a systematic trend in the rank order in which tasks are performed in seven of the eight clinical areas. Correlation coefficients ranged from .93 to .60. In the area of Biochemistry, for example, the rank order coefficient of correlation was .91, indicating that those tasks which have a high

percentage of performance by certified personnel were also performed by a high percentage of non-certified personnel.

In the Mycology area, however, the rank order of percentage performance on tasks between the certified and non-certified respondents was different. The first ranked task for the certified group is Cultivating specimens for primary isolation, and the first ranked task for the non-certified group is Preparing culture media.

The main differences in performance between certified and non-certified respondents occur in difficult non-routine tasks in three clinical areas. Most non-certified workers do not perform the following tasks:

In Hematology, Factor V-VIII-X analysis, Fibrinolysin tests, and Stain and read peroxidase stains;

In Microbiology, Microfilarial examinations;

In Biochemistry, Xylose tolerance tests.

Generalist/Specialist Respondents

A clinical area specialist is a respondent who indicated no more than two clinical areas as his major responsibility. A generalist is a respondent who indicated more than two clinical areas as his major responsibility.

Sixty-four percent of the respondents were generalists and 36 percent were specialists. Biochemistry is the clinical area checked as the major responsibility by the largest percentage of specialists, both certified and non-certified (15%). For the generalist, the major responsibilities were evenly divided among Urinalysis, Hematology, and Biochemistry (16%, 16% and 14% respectively).

An analysis was made of the performance of tasks in each clinical area by the certified/non-certified specialists and generalists.

1. Microbiology Clinical Area

   Only six of the 24 Microbiology tasks were performed by 50 percent or more of the four classifications (certified specialist, non-certified specialist, certified generalist, and non-certified generalist). The six, all Bacteriology tasks, can be grouped under the headings of: Staining Bacteriology smears and Inoculating media (see Table 12, page 25).

   No Mycology or parasitology tasks were performed by 50 percent or more of all classifications. The results of the data shown in Appendix D, page 77, indicate that the Mycology and parasitology tasks are mainly performed by specialists or certified technologists. The only low-performance task (25% or less for all classifications) is Maintain parasitic cultures. Most laboratories, with the exception of research laboratories, identify parasites but do not maintain parasite cultures.

The differences among the Microbiology classifications are evident in the more sophisticated tasks of identifying and classifying microorganisms, fungi, and parasites.

The non-certified generalist group usually does not identify and classify bacteria nor even perform the basic tasks of staining and inoculating tuberculosis, mycology, and parasitology specimens (Table 10, page 23).

Identifying and classifying mycology and parasitology specimens is primarily the responsibility of the certified groups (Table 11, page 24). The task, Preparing Mycology media, is mainly a specialist task. The non-certified specialist workers in this case probably are Mycology media making technicians. The certified specialist may prepare special media for mycology identification problems.

2. Serology Clinical Area

Serology generalists comprise 74 percent of the respondents with a major responsibility in this area.

All classifications have a high performance on simple agglutination procedures such as the rheumatoid arthritis and heterophile tests (Table 14, page 27). According to some experienced microbiologists the reading of these tests is difficult and might require certified or specialist workers.

The four low-performance procedures: Prepare specimens for virus isolation; Identify viruses and/or rickettsia; Perform strep MG test; and Perform fluorescent treponemal antibody test (Table 15, page 27) for the serologic identification of microorganisms require difficult techniques. Few laboratory workers are trained to do them.

The Serology tasks that reveal a major performance difference between classifications relate to the performance and reading of precipitation reactions (Appendix E). These procedures were carried out mainly by certified specialists.

3. Hematology Clinical Area

About three-fourths of the respondents whose major responsibility is Hematology are generalists. Over half of the 33 survey tasks are performed by 50 percent or more of all hematology classifications (Table 16, page 29). These tables include the tests related to the routine complete blood count and the simpler coagulation tests.

Almost none of the respondents perform chromosomal analysis, which is generally limited to research or specialized laboratories. The differences in the task performance among the four Hematology classifications show that on tests such as Fibrinogen deficiency

and Prothrombin consumption, which are performed in other clinical areas besides Hematology, a small percentage of non-certified specialists perform them.

The more difficult tests, such as Factor V-VIII-X assays and Peroxidase stains, are performed mainly by certified technologist specialists (Table 20, page 32).

4. Urinalysis Clinical Area

Approximately three-fourths of the respondents with a major responsibility in Urinalysis were generalists.

As would be expected, the tests that are part of the routine urinalysis are performed by a high percentage of all classifications. These tests include the Urine character, Specific gravity, and Biochemical procedures (Table 21, page 34). The Microscopic analysis was not included because less than 50 percent of the non-certified specialists performed this procedure. (However, the fact that 86 percent of the non-certified generalists perform microscopic urinalyses indicates that this procedure is not limited to specialist or certified groups.)

Non-routine tasks, such as the Pitressen response and Water loading test, are rarely performed. The Urobilinogen test, when performed in the Urinalysis area, is primarily a specialist test.

The Addis count, a more sophisticated procedure, is mainly a certified task; however, a surprisingly high percentage (43%) of non-certified generalist workers perform it.

5. Biochemistry Clinical Area

This area is one of the most difficult to analyze because each laboratory has a different set of tasks which are done regularly by different laboratory workers. The technique used, manual or automated, often determines which group performs the test. For example, three tasks performed by 50 percent or more of the respondents are the LDH, Phosphorus and SGOT determinations. Non-certified workers might perform them in automated laboratories in which an SM 1260 Autoanalyzer was used routinely on each specimen as part of a Panel of 12, or in a smaller laboratory that used one of the rapid "kit" methods. However, if the LDH and SGOT were performed manually in an enzyme section, a certified worker would probably be assigned to do them. In general, the lower-skilled workers will perform the routine, large volume tasks which require reference to few procedures.

There is little difference in performance among Biochemistry classifications as indicated in Appendix H. The percentage of performance by all classifications of respondents with a major responsibility in Biochemistry is similar for most tasks. Differences occur in tasks relating to toxicology, such as the

Alkaloid test (#7*) and the Barbiturate level (#9), and specialized, non-routine tests such as Calculus analyses (#14), Steroid studies (#23) and Xylose tolerance tests (#61).

A task that was assigned to one clinical area might show a low percentage of performance because it was also performed in another area. For example, the Colloidal gold curve (#22), though assigned to Biochemistry and analyzed for those workers, is a Serology test and might be performed in the latter area.

6. Blood Banking Clinical Area

Most of the respondents whose major responsibility is in this area are generalists (75%).

The tasks performed by 50 percent or more of all classifications include not only those directly related to crossmatching of blood, such as group, type, slide and tube agglutination tests, but also antibody screen and reaction studies (Table 32, page 44).

An interesting fact is that although 50 percent or more of workers in all classifications process blood for packed cells (Table 32), only 50 percent or more of the two specialist classifications use a refrigerated centrifuge (Table 34, page 46). While in most cases the processing of blood for packed cells does not require centrifugation, there are occasions, such as when blood is freshly drawn or when the cells and plasma are accidentally mixed, that require the use of the refrigerated centrifuge.

Not all of the respondents who draw blood from donors (Table 33, page 45) perform first aid for shock or take blood pressure or pulse rate (Table 36, page 47), e.g., 80 percent of certified specialists draw blood from donors, but only 60 percent take their blood pressure and/or pulse rate.

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*These are task numbers in Appendix H.

VIII. RECOMMENDATIONS AND CONCLUSIONS

A main purpose of this survey analysis is to determine the appropriateness of the task list as a foundation for curriculum development. First, the curriculum content (tasks) needs to be determined and then the knowledge and skills required for the satisfactory performance of the tasks must be evaluated. Three factors that determine curriculum content are:

1. Task performance
2. Task criticality
3. Technological change

High Performance

One approach to curriculum development should be to use the high-performance tasks as a content nucleus for formulating instructional units. A curriculum based on the high-performance survey tasks would include skills and methods to: clean equipment; inventory and order supplies; prepare solutions; collect and process patients' specimens; operate balances; use centrifuges, pipettes, and temperature control apparatus; and communicate laboratory findings.

The curriculum content should include the skills and knowledge necessary in:

Hematology: to perform the complete blood count (hemoglobin, hematocrit, white count, red count, and differential count), other cell counts (spinal fluid and platelet), the sedimentation rate, and venous coagulation studies.

Urinalysis: to perform the routine urinalysis including macroscopic, biochemical, and microscopic analyses.

Microbiology: to set up cultures (inoculate and incubate) and to stain slides.

Biochemistry: to perform a complete chemical assay, using both manual and automated techniques. The justification for this approach is that in Biochemistry, there are numerous methods for doing each test. New clinical chemistry tests are continually being developed. Instead of acquiring knowledge needed to perform a specific test, a student should learn the basic concepts and techniques in the complete chemical assay. These would include:

a. Quantitatively selecting a portion of the specimen sample.
b. Removing impurities, if necessary.
c. Obtaining a specific reaction for target chemical component.
d. Measuring the amount of the component.
e. Calculating the amount of the component in the sample.

Low Performance

One educational problem concerns deciding where training should be offered for tasks that are rarely ordered or that are performed in specialized laboratory facilities, e.g., research centers. It would appear that training for these tasks would best be done at the site where they are performed. For example, since most medical laboratory workers do not maintain parasite cultures, there seems to be little justification for providing more than basic information about this topic in the general curriculum for medical laboratory students.

Criticality

A highly critical task is one which, improperly performed, could be harmful to the patient or cause damage to equipment. Adequate curriculum content should be provided for a critical task, even though there is low performance. For example, Performing first aid for shock, is a highly critical Blood Bank task performed by only 29 percent of the blood bank certified generalists; however, the curriculum for the training of workers who draw blood from donors should include the instructions for treating shock.

Technological Change

The medical laboratory field is in a constant state of flux. New procedures are presented in almost every edition of laboratory and pathology journals. There are many announcements of new materials and equipment. Automation is replacing numerous manual techniques. Twenty-eight percent of the respondents operate automatic cell counters and over one-third operate automatic analyzers. New equipment calls for new skills. Roger Hamstra, M.D., of the University of Colorado Medical Center, in a recent speech outlining future trends in medical technology, stressed that proficiency with instruments (repair and trouble shooting) is becoming a necessary part of the laboratory workers' skills.* These developments have a large impact on educational and training institutions. Their curricula must include instruction in these newer methods and in maintenance of new equipment if medical laboratory students are to receive adequate training to meet the realities of the world of work.

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*American Society of Medical Technologists' Convention, Las Vegas, Nevada, 1971.

IX. LOOKING AHEAD

In the previous section, curriculum recommendations were based primarily on the performance of tasks by respondents. This task analysis approach to curriculum development has been criticized on the basis that a high rate of performance of a task by a specific category of laboratory worker does not necessarily mean that the worker should be performing it. There are differences of opinion about current practices for determining what type of laboratory worker is needed.

Many laboratory employers dislike certification laws, e.g., California statutory requirements that call for the hiring of highly educated, and therefore better paid, technologists to do most of the laboratory work. They feel that most of the routine bench tasks could be performed just as satisfactorily by less highly trained personnel, such as assistants or technicians.

Professional organizations, on the other hand, want to maintain and upgrade the status of their membership, and accuse the employers of trying to bring in labor that is inadequately qualified and therefore "cheap."

There is justification for both points of view; however, the resolution of the problem of who should be performing laboratory tests lies elsewhere.

More important than laboratory operating costs or individual status, in providing high quality laboratory service, is that whoever performs a laboratory task have the minimum skills and knowledge required to do it within acceptable limits of time and accuracy. The "task," as used here, means all the manual (motor) operations and mental decisions that are needed to carry out a test or procedure.

A starting point to determining the skills and knowledge required for each task is to formulate a complete task list, such as Appendix Q. Each task could be then divided into its component processes. A process is a continuous set of operations that is routinely performed by one individual, i.e., two or more individuals do not usually do parts of a single process. For example, the task, Performing a sensitivity test, in microbiology, is made up of two main processes:

Process 1: Setting up the sensitivity plate.
Process 2: Reading the plate.

For Process 1, a microbiology worker generally performs the techniques and makes the decisions needed to (a) pick off an isolated colony for the test from one of the primary culture plates; (b) inoculating it in broth; (c) streak it on the sensitivity plate; and (d) place the appropriate sensitivity discs on it and incubate the sensitivity plate.

For Process 2, a second worker often performs the sensitivity reading at the appropriate time.

The third step is to determine the skills and knowledge needed for each process.

The final step is to decide whether a specific laboratory worker should be permitted to perform a specified task. He may perform the task if he possesses all the skills and knowledge required for the processes that make up the task. If he has the skills and knowledge for only part of the task, e.g., a process, then he may perform only that process. In the above example, an individual might qualify to perform Process 2, Reading a sensitivity plate, but not be able to adequately perform Process 1, Setting up the plate.

Assume that an evaluation is to be made of the two processes in the microbiology task, Setting up a primary urine culture plate, and Setting up a secondary urine sub-culture plate, to determine who could perform each. At first glance, the two appear similar, since both require streaking a plate. However, upon making a knowledge/skill analysis, major differences are apparent.

KNOWLEDGE/SKILL ANALYSIS

Process: Setting up a Primary Urine Culture Plate

Operational Steps:

1. Accept or reject a urine specimen as suitable for culturing.

   Knowledge of:

   a. The appearance of a sterile container.

   b. What information should be on request slip, e.g., patient identification, date, and time of collection.

   c. The maximum allowable time between collection and culturing.

   d. Evidences of contamination, e.g., top not on properly or crack in container.

2. Select a proper inoculating loop.

   Knowledge of: The appearance of a 0.01 ml. loop, if quantitative loop is used.

3. Select culture plates.

   Knowledge of:

   a. The type of plates used for urine culture.

b. The kind of media in the plate by its appearance and label.

c. The appearance of a contaminated plate.

4. Light the gas burner.

Knowledge of:

a. The location of knobs (air, gas, outlet).

b. How to manipulate the knob.

c. How to adjust the burner for optimum flame.

Skills to:

a. Hold match in flame.

b. Manipulate knobs.

5. Sterilize the inoculating loop.

Knowledge of:

a. How to hold loop in proper part of flame.

b. How to recognize when loop is sterile.

Skills to: Hold and move needle in flame.

6. Allow the loop to cool.

Knowledge of: How to cool loop without contaminating it.

7. Remove the sample from specimen.

Knowledge of:

a. How to obtain a representative sample of the specimen.

b. How to maintain aseptic conditions.

Skills to:

a. Open container using aseptic conditions.

b. Insert loop to proper depth in specimen.

c. Hold loop to prevent contamination.

8. Streak the primary plate.

Knowledge of:

a. How to maintain aseptic conditions while streaking plate.

b. How to streak plate for optimum isolation.

Skills to: Streak plate without cutting into agar.

Process: Setting up a Secondary Urine Sub-culture Plate

Operational Steps:

1. Determine whether a sub-culture is required.

Knowledge of:

a. What indicates that a pathogen may be present.

b. What a pathogen looks like from colony morphology and its appearance on selective media.

2. Select the proper colony for sub-culturing.

Knowledge of:

a. The appearance of an isolated colony.

b. The appearance of the isolated colony to be sub-cultured.

c. The presence of other colonies that may be growing below the isolated colony.

3. Select an inoculating needle.

Knowledge of: The appearance of an inoculating needle.

4. Select a culture plate (same as Step 3, Primary culture).

5. Light the gas burner (same as Step 4, Primary culture).

6. Sterilize an inoculating needle (same as Step 5, Primary culture).

7. Cool the needle (same as Step 6, Primary culture).

8. Remove part of colony from primary culture plate.

   Knowledge of: The amount and what part of the colony should be removed.

   Skills to: Remove the part of the colony.

9. Streak the sub-culture plate (same as Step 8, Primary culture).

10. Sterilize the needle (same as Step 9, Primary culture).

EVALUATION OF THE PROCESSES

All operations in the two processes require similar manual skills.

The two processes call for similar knowledge in the following operations:

1. Selecting inoculating instruments.
2. Lighting the burner.
3. Sterilizing the inoculating instrument.
4. Cooling the inoculating instrument.
5. Streaking the plate.

The two processes differ in their initial steps. The process, Setting up a primary urine culture, requires a decision to accept or reject a specimen. The knowledge required for this operation is basic and can be learned in a short time at the place where the task is performed. No prior courses or training are needed.

In contrast, the process, Setting up a urine sub-culture, requires an evaluation to determine if a sub-culture is needed and then to select the proper colony (colonies) for sub-culturing. The knowledge required is more complex. There is the possibility that the colonies present are contaminants. Therefore, a knowledge of the colony morphology and number is required. The presence of more than one type of colony is an important factor. Distinguishing between two closely related microorganisms requires the recognition of slight differences in colony morphology by a trained observer. If more than one type of colony is present, one must ascertain if one or both should be sub-cultured. Another decision that must be made is whether a sensitivity plate should also be set up.

The process of setting up a sub-culture, therefore, requires an individual with a somewhat better microbiology background that one who is limited to inoculating a primary culture.

This same four-step method can be used in each laboratory department or clinical area to determine who should perform a task or a cluster of tasks requiring the same levels of skills and knowledge.

Step 1: Prepare a task list.
Step 2: List the processes for each task.
Step 3: List the skills and knowledge for each process.
Step 4: Determine if the laboratory worker posesses the skills and knowledge needed to perform the process or task.

One main advantage of using this skills/knowledge process approach is that the occupational requirements for the medical laboratory field can be determined with a high degree of uniformity. The same skills and knowledge are required for a process performed in a 300-bed modern city hospital laboratory as for the same process performed in a 50-bed remote Alaskan hospital.

This report has outlined an approach to curriculum development and recommended a method to determine a laboratory worker's suitability to perform an assigned job. Until the laboratory worker's role is clearly defined on a national level by professionals, the medical laboratory field will continue to be fragmented. Legislative bodies and others outside the field will impose regional restrictions, many not in the best interest of sound laboratory medicine. It is hoped that a national consortium will be formed to deal with these problems, as a step toward achieving a unified profession.

HT:mh
M. Ellison, Editor
S. Grossman, Editor
AHPP 7/71

APPENDIX A

TABULATED BACKGROUND DATA OF TOTAL RESPONDENT SAMPLE (N=224)

Laboratory Facility Background

CHARACTERISTIC	RESPONDENTS	
	n	%
Geographic Area		
Los Angeles	94	42
Seattle	42	19
Denver	42	19
Chicago	12	5
Birmingham	15	7
Boston	19	9
Facility Type *		
Non-profit Hospital	132	61
Proprietary Hospital	31	14
Independent Laboratory	53	25
Beds in Hospital		
1 - 49	0	0
50 - 99	15	9
100 - 199	43	27
200 - 299	39	24
300 or more	65	40
Licensed or Certified Laboratory Personnel in Facility **		
0 - 1	0	0
2 - 5	52	25
6 - 10	46	23
11 - 20	60	29
21 - 50	26	13
57 - 100	21	10
Greater than 100	0	0
Years Worked in All Laboratories ***		
Less than 1 year	2	1
1 - 2 years	29	13
3 - 5 years	58	26
6 - 9 years	39	18
10 - 15 years	36	17
15 or more years	56	25
(Mean = 6-9 yrs. Median = 6-9 yrs. Mode = 3-5 yrs.)		

* 8 respondents (4%) gave no answer
** 19 respondents (8%) gave no answer
*** 4 respondents (2%) gave no answer

APPENDIX A

TABULATED BACKGROUND DATA OF TOTAL RESPONDENT SAMPLE (N=224)

(Continued)

CHARACTERISTIC	RESPONDENTS	
	n	%
Years Worked in Present Laboratory *		
Less than 1 year	2	1
1 - 2 years	69	31
3 - 5 years	79	35
6 - 9 years	25	11
10 - 15 years	27	12
15 or more years	21	10
(Mean = 6 yrs. Median = 3 yrs. Mode = 3 yrs.)		
Sex **		
Male	82	37
Female	138	63
Marital Status ***		
Single	66	30
Married	137	63
Divorced	8	4
Separated	1	1
Widowed	5	2
Age ***		
18 - 20	2	1
21 - 30	89	41
31 - 40	47	22
41 - 50	61	28
51 - 64	15	7
65 or older	3	1
(Mean = 36 yrs. Median = 33 yrs. Mode = 25 yrs.)		
Yearly Salary ****		
Less than $5,000	16	7
5,000 - 7,999	66	30
8,000 - 10,999	92	43
11,000 - 13,999	35	16
14,000 - 16,999	6	3
17,000 or more	3	1
(Mean = $5,000 - $7,000 Median = $5,000 - $7,000 Mode = $8,000 - $10,999		

* 37 respondents (16%) gave no answer
** 4 respondents (2%) gave no answer
*** 7 respondents (3%) gave no answer
**** 6 respondents (3%) gave no answer

APPENDIX A

TABULATED BACKGROUND DATA OF TOTAL RESPONDENT SAMPLE (N=224)

Education and Training

CHARACTERISTIC	RESPONDENTS	
	n	%
Years of School Completed *		
9 - 12 years	30	14
13 years	16	7
14 years	23	11
15 - 16 years	92	42
16 or more years	58	26
(Mean = 14 yrs. Median = 14 yrs. Mode = 15-16 yrs.)		
Highest Degree Obtained **		
Less than high school diploma	1	0.5
High school diploma	64	30
Associate degree	14	7
Bachelor's degree +	116	55.5
Master's degree +	12	6
Doctors degree	2	1
Medical Training ***		
None	1	1
On-the-job	149	68
Military	33	15
Manufacturer's course	11	5
Vocational school	19	9
College or university	128	59
School of medical technology	12	6
Year Training Was Completed ****		
Prior to 1941	7	4
1941 - 1945	8	5
1946 - 1949	14	7
1950 - 1959	37	20
1960 - 1969	107	57
1970	14	7

* 5 respondents (2%) gave no answer
** 15 respondents (7%) gave none of these choices
*** Total percent is greater than 100 since more than one choice was requested.
**** 37 respondents (16%) gave no answer
\+ 85% of bachelor's degrees and 83% of master's degrees are in an academic science.

APPENDIX A

TABULATED BACKGROUND DATA OF TOTAL RESPONDENT SAMPLE (N=224)

Major Responsibilities

CHARACTERISTICS	RESPONDENTS	
	n	%*
Bacteriology	37	16
Biochemistry	74	33
Blood Bank	32	14
Hematology	55	24
Serology	32	14
Urinalysis	55	24
General (rotation)	49	22
Cytotechnology	18	8
Histology	21	9
Supervisor	47	21
Research	21	9

*Total percent is greater than 100 since more than one choice was requested.

APPENDIX B

INTERPRETATION OF CERTIFIED/NON-CERTIFIED BACKGROUND DATA

Age

The majority (about two-thirds) of both certified groups are relatively young (see Table B1 on next page). A survey[1] conducted by the American Society of Clinical Pathologists in 1967 reported that three-quarters of the respondents were under 40. The results of the present survey support this finding.

Most of the non-certified group (46%) as compared to 36 percent in the non-certified group are in the age bracket designated 30 or younger. This can be explained by the fact that the certified group require many more years of education to achieve their status (see Table B2).

Marital Status

The statistics appearing in this category indicate that a majority of both certified and non-certified technologists are married.

Sex

Although females predominate in both groups (67% and 56%), the percentage of males is greater in the non-certified groups (see Table B1). Previously, about 90 percent of the ASCP registered technologists were women.[2] Seventy-six percent of MT (ASCP) are wormen. In 1964 about 75 percent of the clinical laboratory technologists in California were women;[3] in contrast only 35 percent of the respondents who are in this certification are women.

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[1] Health Manpower Council of California, 1970 California Health Manpower, Clinical Laboratory Technologists, August 1970, p. 9.

[2] Franke, W. and I. Sobel, The Shortage of Skilled and Technical Workers, Institute of Industrial Relations, University of Illinois, June 1968, p. 55.

[3] Health Manpower Council of California, op. cit.

TABLE B1

SOCIO-ECONOMIC CHARACTERISTICS

CHARACTERISTIC	CERTIFIED Percent (n=107)	NON-CERT. Percent (n=79)
Age		
18 - 20	0	3
21 - 30	36	43
31 - 40	27	15
41 - 50	30	29
51 - 64	5	9
65 or older	2	1
Marital Status *		
Single	30	30
Married	63	67
Divorced	5	1
Separated	0	1
Widowed	2	1
Sex **		
Male	33	44
Female	67	56
Yearly Salary ***		
Less than $5,000	0	17
5,000 - 7,999	18	45
8,000 - 10,999	51	29
11,000 - 13,999	25	9
14,000 - 16,999	5	0
17,000 or more	1	0

* 1 certified (1% of total) and 2 non-certified (2% of total) respondents gave no answer

** 1 non-certified respondent (1% of total) gave no answer

*** 3 certified (3% of total) and 1 non-certified (1% of total) respondents gave no answer

Yearly Salary

The annual salary appears to correlate with education (see Table B1). Over twice as many certified as non-certified personnel earn a salary of $11,000 per year or more. None of the non-certified group earns $14,000 or more, but 6 percent of the certified do. None in the certified category earns less than $5,000; however, 17 percent of the non-certified do.

Years of School Completed and Highest Degree Obtained

The largest difference between the certified and non-certified categories occurs in education-related background data. Twice as many certified personnel have completed 15 or more years of school, and almost four times as many have earned a bachelor's degree. On the other hand, a high school diploma is listed as the top education level by more than half of the non-certified group (see Table B2).

Medical Laboratory Training

A similar trend is apparent with respect to the type of training received. About three times as many certified people listed college/university as part of their medical laboratory training, whereas non-certified personnel indicated a higher percentage of on-the-job, military, and vocational training (see Table B2).

Year Training Was Completed

Over half of the respondents in both categories completed their training within the past ten years. In the survey year of 1970 a much higher percentage of non-certified (15%) than certified (2%) finished training.

Geographic Area

The largest percentage of certified and non-certified respondents work in the western part of the United States (see Table B3).

Type of Facility

About three-quarters of each of these certified groups work in hospital laboratories; the rest are employed in independent laboratories (see Table B3).

TABLE B2

EDUCATION AND TRAINING

CHARACTERISTIC	CERTIFIED Percent (n=107)	NON-CERT. Percent (n=79)
Years of School Completed *		
9 - 12 years	1	27
13 years	2	10
14 years	4	16
15 - 16 years	60	30
16 or more	33	17
Highest Degree Obtained **		
Less than high school diploma	0	1
High school diploma	4	60
Associate degree	5	7
Bachelor's degree	86	25
Master's degree	5	7
Doctor's degree	0	0
Medical Training ***		
None	0	0
On-the-job	58	76
Manufacturer's course	7	4
Military	12	20
Vocational school	6	14
College or university	84	30
Year Training Was Completed		
Prior to 1941	5	2
1941 - 1945	5	4
1946 - 1949	7	8
1950 - 1959	20	23
1960 - 1969	61	48
1970	2	15

* 1 certified respondent (1% of total) gave no answer
** 7 non-certified respondents (9% of total) gave no answer
*** total percent is greater than 100 since more than one choice was required

Number of Hospital Beds

The majority of both certified and non-certified personnel employed in hospitals work in large hospitals of 200 or more beds. There are, however, 10 percent more certified than non-certified technologists employed in smaller hospitals of less than 200 beds. This might indicate that more training is needed for positions in smaller facilities, where fewer technologists are responsible for wider laboratory coverage.

Years Worked

More certified than non-certified technologists have worked in their present position (and in all laboratories) for 10 years or longer (see Table B3). This occupational longevity may be explained by a greater commitment as a result of the educational and licensure requirements. Undoubtedly, the reward of larger salaries is a contributing factor to this permanence.

As might be expected, more non-certified than certified workers have been employed for two years or less. Non-certified specialists, such as chemists or microbiologists, often seek temporary employment in the clinical laboratory while working toward advanced degrees, and this may account in part for this impermanence.

On the other hand, although the survey shows that fewer non-certified technologists work longer than 10 years, many of them leave their jobs in order to continue their education and acquire certification, and ultimately to become a part of the certified group.

Major Responsibilities

The respondents were asked to indicate one or more areas of major responsibility. The responses to the question about major on-the-job responsibilities are summarized in Table B4. There are only two areas where there is a significant difference between the certified and non-certified technologists: Histology (P is less than 0.01) and Supervisory (P is less than 0.02).

TABLE B3

FACILITY AND GENERAL BACKGROUND

CHARACTERISTIC	CERTIFIED Percent (n=107)	NON-CERT. Percent (n=79)
Geographic Area		
Los Angeles	38	44
Seattle	25	15
Denver	21	11
Chicago	3	8
Birmingham	7	8
Boston	6	14
Facility Type *		
Non-profit hospital	57	69
Proprietary hospital	18	12
Independent laboratory	25	19
Number of Hospital Beds		
50 - 99	10	8
100 - 199	27	19
200 - 299	21	25
300 or more	42	48
Total Years Worked in All Laboratories **		
1 - 2 years	9	21
3 - 5 years	30	21
6 - 9 years	14	21
10 - 15 years	16	18
15 or more years	31	19
Years Worked in Present Laboratory ***		
1 - 2 years	27	41
3 - 5 years	38	30
6 - 9 years	11	11
10 - 15 years	15	9
15 or more years	9	9
Total Survey Sample (N=224)	48	35

* 6 certified respondents (6% of total) gave no answer
** 5 non-certified respondents (5% of total) gave no answer
*** 1 certified respondent (1% of total) worked less than 1 year

TABLE B4

MAJOR RESPONSIBILITIES

CHARACTERISTIC	CERTIFIED Percent (n=107)	NON-CERT. Percent (n=79)
Bacteriology	16	22
Biochemistry	39	27
Blood Bank	20	9
Hematology	26	24
Serology	21	10
Urinalysis	25	25
General (rotation)	27	16
Cytotechnology	6	6
Histology	2	15
Supervisor	29	13
Research	6	10

* Total percent is greater than 100 since more than one choice was required.

APPENDIX C

OTHER CERTIFICATIONS AND SPECIALTIES
OF RESPONDENT SAMPLE (N=224)

CERTIFICATION	NUMBER	PERCENT
CLA (ASCP)	3	1
MLT (ASCP)	1	0.5
CT (ASCP)	5	2
HT (ASCP)	7	3
AMT	4	2
CLT (Chemistry)	3	1
Ph.D. Specialists	2	1
Foreign Certifications	2	1

None of these respondents was included in the certified/non-certified groups. Those having American Medical Technologist Registry (AMT) had varied educational backgrounds. Two listed a high school diploma and one a bachelor's degree; the other indicated having completed 13 years of school.

The foreign certifications included an AIMLT from Great Britain and a certificate from Yugoslavia.

One of the Ph.D. holders had a specialist's California license in microbiology and the other was a registered National Clinical Chemist.

APPENDIX D

PERCENT PERFORMANCE BY RESPONDENTS ON MICROBIOLOGY PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=9)	CERTIFIED GENERALISTS %CG (n=13)	NON-CERTIFIED GENERALISTS %NCG (n=8)
PERFORMING BACTERIOLOGICAL PROCEDURES				
1. Examine specimens microscopically.	100	78	100	64
2. Identify and classify pathogenic bacteria.	100	78	100	25
3. Inoculate tubed media.	100	89	92	62
4. Maintain stock cultures.	80	78	54	12
5. Operate anaerobic devices.	100	78	85	12
6. Perform animal inoculations.	40	33	23	12
7. Perform animal virulence tests.	40	0	15	0
8. Perform antibiotic and antimicrobial agent sensitivity tests.	80	78	77	38
9. Perform fluorescent antibody studies.	20	44	23	0
10. Prepare autogenous vaccines.	20	22	31	0
11. Prepare culture media.	100	89	77	38
12. Prepare subculture and smears.	100	100	85	38
13. Receive and primary process all cultures except blood, T.B., and fungus.	80	78	92	62
14. Receive and process T.B. cultures.	80	67	77	25
15. Receive and process blood cultures.	80	67	100	62
16. Record and/or report colony counts on urine.	80	56	92	38
17. Record and/or report colony counts on other than urine.	60	22	69	12
18. Stain bacteriological smears.	100	89	100	75
19. Streak plates.	100	100	100	88

APPENDIX D

PERCENT PERFORMANCE BY RESPONDENTS ON MICROBIOLOGY PROCEDURES

(Cont'd)

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=9)	CERTIFIED GENERALISTS %CG (n=13)	NON-CERTIFIED GENERALISTS %NCG (n=8)
PERFORMING MYCOLOGY PROCEDURES				
1. Cultivate mycology specimens for primary isolation.	100	67	92	12
2. Examine mycology specimens microscopically.	100	56	77	12
3. Identify and classify fungi.	80	44	69	12
4. Perform KOH preparation for dermatophytes.	80	44	69	12
5. Prepare culture media.	80	89	46	25
6. Stain mycology specimens.	100	56	61	12
PERFORMING PARASITOLOGY PROCEDURES				
1. Examine specimens macroscopically.	80	56	77	12
2. Examine specimens microscopically.	80	56	92	38
3. Identify parasitic and disease-carrying arthropods.	60	36	62	12
4. Identify protozoans, cestodes, nematodes, and trematodes.	80	44	85	12
5. Maintain parasite cultures.	20	0	23	12
6. Perform concentration and flotation techniques.	80	67	85	12
7. Perform microfilarial examinations.	60	11	46	12
8. Perform serological tests for parasites (e.g., trichinosis).	40	0	38	0
9. Stain parasitological smears.	60	56	69	12

APPENDIX E

PERCENT PERFORMANCE BY RESPONDENTS ON SEROLOGY PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=2)	CERTIFIED GENERALISTS %CG (n=17)	NON-CERTIFIED GENERALISTS %NCG (n=6)
1. Identify viruses and/or rickettsia.	0	0	18	0
2. Perform antistreptolysin "O" titers.	60	100	71	67
3. Perform cardiolipin microflocculation test.	40	50	47	17
4. Perform colloidal gold test.	40	0	53	0
5. Perform complement fixation tests.	60	50	35	17
6. Perform "C" reactive protein tests.	40	50	82	67
7. Perform febrile agglutination (e.g., salmonella) tests.	40	0	82	50
8. Perform fluorescent treponemal antibody test.	20	0	18	0
9. Perform hemagglutination inhibition test.	20	0	35	0
10. Perform heterophile presumptive test.	60	100	71	67
11. Perform infectious mononucleosis procedures - monospot or monotest.	60	100	88	50
12. Perform latex fixation test.	80	100	76	50
13. Perform rheumatoid arthritis test (RA)	80	100	71	83
14. Perform and read fluorescent antigen-antibody tests.	40	50	18	17
15. Perform skin tests.	20	0	41	0
16. Read skin tests.	20	0	35	0
17. Perform and read agglutination tests (e.g., cold agglutinations).	60	50	77	50
18. Perform and read flocculation tests (other than serological tests for syphilis).	40	0	59	50
19. Perform and read precipitation reactions (e.g., agar gel immunodiffusion).	60	0	18	17

APPENDIX E

PERCENT PERFORMANCE BY RESPONDENTS ON SEROLOGY PROCEDURES

(Cont'd)

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=2)	CERTIFIED GENERALISTS %CG (n=17)	NON-CERTIFIED GENERALISTS %NCG (n=6)
20. Perform strep MG test.	0	0	18	0
21. Perform thyroid antibody test.	40	0	24	0
22. Perform VDRL test.	40	100	76	67
23. Perform other serological tests for syphilis.	20	0	41	50
24. Prepare antigens.	80	50	47	50
25. Prepare and read hemolysin reactions.	40	0	41	33
26. Prepare specimens for virus isolation.	0	0	12	0

AHPP

APPENDIX F

PERCENT PERFORMANCE BY RESPONDENTS ON HEMATOLOGY PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=6)	NON-CERTIFIED SPECIALISTS %NCS (n=6)	CERTIFIED GENERALISTS %CG (n=22)	NON-CERTIFIED GENERALISTS %NCG (n=13)
1. Perform bleeding time procedures.	67	83	96	62
2. Prepare and stain blood smears.	100	83	96	85
3. Perform bone marrow examinations on specimens.	33	0	27	15
4. Perform capillary resistance test.	33	17	32	23
5. Perform chromosomal analysis.	0	0	9	0
6. Perform clot retraction test.	100	67	86	62
7. Perform venous whole blood coagulation time tests.	67	83	91	69
8. Perform cryoglobulin tests.	33	0	23	15
9. Perform differential cell counts.	100	67	96	77
10. Perform eosinophile count.	83	50	73	54
11. Perform erythrocyte fragility tests.	67	33	64	38
12. Calculate erythrocyte indices.	100	83	77	62
13. Perform factor V - VIII - X assays.	50	0	36	15
14. Perform fibrinogen deficiency test.	67	17	50	54
15. Perform fibrinolysin tests.	83	17	50	8
16. Perform hematocrit tests.	100	83	96	100
17. Perform hemoglobin tests.	100	83	96	100
18. Prepare lupus erythematosus (L.E.) slides.	100	67	86	54
19. Microscopically identify L.E. cells.	83	33	73	31
20. Stain and read malaria smears.	33	33	64	46
21. Identify morphological variations of red or white blood cells.	100	50	96	77

AHPP

APPENDIX F

PERCENT PERFORMANCE BY RESPONDENTS ON HEMATOLOGY PROCEDURES

(Cont'd)

TASK	CERTIFIED SPECIALISTS %CS (n=6)	NON-CERTIFIED SPECIALISTS %NCS (n=6)	CERTIFIED GENERALISTS %CG (n=22)	NON-CERTIFIED GENERALISTS %NCG (n=13)
22. Perform partial thromboplastin time (PTT) test.	67	67	91	62
23. Stain and read peroxidase stain.	67	17	41	8
24. Perform platelet count.	100	67	91	85
25. Perform prothrombin consumption test.	50	17	59	15
26. Perform prothrombin time test.	100	67	91	77
27. Perform red blood count.	100	67	96	77
28. Perform reticulocyte cell count.	100	50	91	62
29. Perform erythrocyte sedimentation rate.	100	83	96	85
30. Perform sickle cell preparations.	100	0	82	38
31. Perform spinal fluid cell counts.	83	33	86	77
32. Perform thromboplastin generation tests.	0	17	37	8
33. Perform white blood count.	100	83	96	92

AHPP

APPENDIX G

PERCENT PERFORMANCE BY RESPONDENTS ON URINALYSIS PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=8)	CERTIFIED GENERALISTS %CG (n=22)	NON-CERTIFIED GENERALISTS %NCG (n=14)
1. Examine urine specimens macroscopically.	80	50	96	79
2. Examine urine specimens microscopically.	60	38	96	86
3. Perform acetone or ketone tests.	60	50	96	79
4. Perform Addis counts.	60	0	59	43
5. Perform Bence-Jones protein tests.	60	50	73	79
6. Perform bile tests.	60	62	91	79
7. Perform bilirubin test.	60	38	77	86
8. Perform concentration test (e.g., Fishberg).	60	12	32	21
9. Perform concentration-dilution tests (e.g., Mosenthal).	60	0	41	7
10. Perform true glucose tests.	80	50	86	79
11. Perform urine hemoglobin (blood) test.	60	50	96	64
12. Perform hemosiderin tests.	40	0	14	7
13. Perform microscopic test for lipids (fats).	60	12	36	21
14. Perform pH tests.	60	62	91	86
15. Perform phenylpyruvic acid tests.	40	12	32	21
16. Perform pitressin response concentration tests.	0	0	9	0
17. Perform porphyrins tests.	60	25	54	36
18. Perform pregnancy tests.	20	38	91	71
19. Perform qualitative urine protein tests.	60	62	84	79
20. Perform urine reducing substance.	60	25	59	21

AHPP

APPENDIX G

PERCENT PERFORMANCE BY RESPONDENTS ON URINALYSIS PROCEDURES

(Cont'd)

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=8)	CERTIFIED GENERALISTS %CG (n=22)	NON-CERTIFIED GENERALISTS %NCG (n=14)
21. Perform specific gravity tests.	60	50	96	86
22. Perform toxicological tests (e.g., lead).	0	12	27	7
23. Perform urobilinogin tests.	60	25	82	64
24. Perform water loading test (e.g., Soffer).	0	0	9	0

AHPP

APPENDIX H

PERCENT PERFORMANCE BY RESPONDENTS ON BIOCHEMISTRY PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=23)	NON-CERTIFIED SPECIALISTS %NCS (n=11)	CERTIFIED GENERALISTS %CG (n=20)	NON-CERTIFIED GENERALISTS %NCG (n=11)
1. Perform acid gel reaction test.	0	0	15	9
2. Perform acid phosphatase test.	74	64	75	91
3. Perform serum albumin tests.	83	36	75	91
4. Perform A/G Ratio.	70	46	75	82
5. Perform blood alcohol test.	26	36	50	18
6. Perform alkaline phosphatase test.	78	44	85	91
7. Perform alkaloids test.	17	9	25	0
8. Perform amylase test.	83	44	90	82
9. Perform barbiturate level test.	52	27	65	18
10. Perform bilirubin (direct) test.	87	36	95	82
11. Perform bilirubin (indirect) test.	83	36	95	82
12. Perform bromosulphalein retention (BSP) test.	74	36	80	74
13. Perform calcium tests.	74	46	90	82
14. Perform calculus analyses tests.	39	27	50	9
15. Perform carbon dioxide determinations.	78	36	85	64
16. Perform carbon monoxide determinations.	35	36	50	18
17. Perform catecholamine tests.	35	27	40	9
18. Perform cephalin flocculations.	61	54	85	73
19. Perform chlorides tests.	83	36	90	82
20. Perform total cholesterol tests.	70	27	85	82
21. Perform total cholesterol esters tests.	35	27	30	18
22. Perform colloidal gold curve tests.	17	18	60	18
23. Perform steroid studies.	30	0	35	0

APPENDIX H

PERCENT PERFORMANCE BY RESPONDENTS ON BIOCHEMISTRY PROCEDURES

(Cont'd)

TASK	CERTIFIED SPECIALISTS %CS (n=23)	NON-CERTIFIED SPECIALISTS %NCS (n=11)	CERTIFIED GENERALISTS %CG (n=20)	NON-CERTIFIED GENERALISTS %NCG (n=11)
24. Perform creatine tests.	56	46	45	64
25. Perform creatine phosphokinase (CPK) tests.	56	54	55	46
26. Perform serum creatinine tests.	74	46	90	73
27. Perform creatinine clearance tests.	65	36	75	36
28. Perform enzyme analysis tests.	70	73	60	46
29. Perform gastric analysis tests (e.g., acidity or Diagnex Blue).	56	18	80	54
30. Perform glucose tests.	78	46	95	82
31. Perform Glucose -6- Phosphate dehydrogenase tests.	35	18	30	0
32. Perform glucose tolerance tests.	65	18	90	73
33. Perform serum glutamic oxalacetic transaminase (SGOT) test.	78	64	80	73
34. Perform serum glutamic pyruvic transaminase (SGPT) test.	70	54	70	73
35. Perform hormonal steroid assays.	26	18	25	0
36. Perform icterus index tests.	48	36	60	46
37. Perform insulin tolerance tests.	35	18	35	9
38. Perform lactic dehydrogenase (LDH) tests.	78	64	75	91
39. Perform Leucine aminopeptidase (LAP) tests.	22	36	35	0
40. Perform lipase tests.	61	36	65	27
41. Perform lipids profile tests.	48	18	35	9
42. Perform serum magnesium tests.	44	0	40	9
43. Perform non-protein nitrogen (NPN) tests.	22	18	25	27

APPENDIX H

PERCENT PERFORMANCE BY RESPONDENTS ON BIOCHEMISTRY PROCEDURES

(Cont'd)

TASK	CERTIFIED SPECIALISTS %CS (n=23)	NON-CERTIFIED SPECIALISTS %NCS (n=11)	CERTIFIED GENERALISTS %CG (n=20)	NON-CERTIFIED GENERALISTS %NCG (n=11)
44. Perform blood oxygen tests.	35	18	50	36
45. Perform blood pH tests.	44	27	65	46
46. Perform phenosulfonphthalein (PSP) excretion test.	35	27	60	46
47. Perform phosphorus tests.	70	46	80	82
48. Perform potassium determinations.	78	46	85	91
49. Perform urine prophyrin and/or porphobilriogen tests.	44	17	55	36
50. Perform frog test for pregnancy.	13	9	15	9
51. Perform slide or tube test for pregnancy.	39	18	90	64
52. Perform protein bound iodine (PBI) tests.	30	18	45	0
53. Perform total protein tests.	74	46	65	91
54. Perform salicylate level tests.	65	36	80	36
55. Perform sodium determinations.	78	36	85	82
56. Perform thymol turbidity tests.	56	54	80	73
57. Perform tolbutamide (orinase) tolerance tests.	26	9	40	9
58. Perform blood urea nitrogen (BUN) tests.	74	36	90	82
59. Perform qualitative urine chemistry tests for any of the serum or blood chemistry tests previously listed (e.g., urine amylase).	74	54	70	64
60. Perform vitamin assays.	22	9	30	0
61. Perform xylose tolerance tests.	48	18	55	0

APPENDIX I

PERCENT PERFORMANCE BY RESPONDENTS ON BLOOD BANKING PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=2)	CERTIFIED GENERALISTS %CG (n=16)	NON-CERTIFIED GENERALISTS %NCG (n=4)
1. Accumulate and maintain blood bank statistics.	100	50	50	75
2. Attach serial numbers to unit.	100	100	25	100
3. Calibrate centrifuges.	100	100	31	20
4. Centrifuge and separate serum from clot.	100	100	94	100
5. Check and record temperatures of refrigerators and/or alarms.	100	100	62	80
6. Crossmatch blood.	100	100	94	100
7. Dispose of unused blood after expiration time limit.	100	100	38	80
8. Draw blood from donors.	80	50	25	80
9. Maintain blood inventory (e.g., count number of bottles on hand).	100	100	69	80
10. Maintain donor files	100	0	25	60
11. Maintain files of blood banking forms including labels.	100	50	25	60
12. Order blood by phone from suppliers.	100	50	81	100
13. Order and maintain reagents and supplies.	100	100	50	60
14. Organize and store blood.	100	50	69	80
15. Perform absorption technique.	100	50	38	20
16. Perform antibody screen and identification tests.	100	100	88	100
17. Perform antibody titers (dilutions).	100	100	75	60
18. Perform direct and indirect Coombs tests.	100	100	94	100
19. Perform elution technique.	100	50	44	20

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APPENDIX I

PERCENT PERFORMANCE BY RESPONDENTS ON BLOOD BANKING PROCEDURES

(Cont'd)

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=2)	CERTIFIED GENERALISTS %CG (n=16)	NON-CERTIFIED GENERALISTS %NCG (n=4)
20. Perform first aid for shock.	80	0	29	20
21. Perform genotype of blood.	100	50	69	80
22. Perform transfusion reaction studies.	100	100	69	100
23. Prepare blood for shipment.	80	50	38	40
24. Prepare and read slide agglutination reactions.	100	100	88	100
25. Prepare and read tube agglutination reactions.	100	100	88	100
26. Prepare controls.	100	50	44	40
27. Prepare special blood fractions (e.g., platelet rich blood).	80	50	19	40
28. Process blood for packed cells.	80	100	50	80
29. Record information on blood record card.	100	50	69	80
30. Screen and schedule donors.	100	0	31	40
31. Store and/or dispose of used blood containers and pilot tubes.	100	100	50	100
32. Take blood pressure of donors and/or pulse rate.	60	0	25	40
33. Test blood for ABO grouping and ABO subgrouping.	100	100	94	60
34. Test blood for Rh or Du factors.	100	100	94	60
35. Use refrigerated centrifuge.	60	50	19	20

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APPENDIX J

PERCENT PERFORMANCE BY RESPONDENTS ON CYTOTECHNOLOGY PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=5)	NON-CERTIFIED SPECIALISTS %NCS (n=4)	CERTIFIED GENERALISTS %CG (n=1)	NON-CERTIFIED GENERALISTS %NCG (n=2)
1. Coverslip specimens.	80	100	0	100
2. Obtain breast discharge specimens.	20	50	0	0
3. Obtain gastric specimens.	40	25	0	0
4. Obtain pleural fluid specimens.	20	50	0	0
5. Obtain salivary aspirates.	20	50	0	0
6. Obtain surface lesion specimens.	20	25	0	0
7. Obtain urine specimens.	20	50	0	0
8. Prepare fixatives.	80	75	0	50
9. Prepare specimens using millipore.	60	50	0	50
10. Prepare specimens using nucleopore.	60	25	0	0
11. Prepare stains and alcohol dilutions.	60	50	0	100
12. Screen breast discharge smear for malignant cells.	40	75	0	0
13. Screen pleural fluid for malignant cells.	80	75	0	0
14. Screen salivary aspirates for malignant cells.	40	75	0	0
15. Screen spinal fluids for malignant cells.	60	75	0	0
16. Screen sputum smear for malignant cells.	60	75	0	0
17. Screen surface lesion for malignant cells.	60	50	0	0
18. Screen thyroid aspirates for malignant cells.	20	25	0	0
19. Screen urine smear for malignant cells.	60	75	0	0

APPENDIX K

PERCENT PERFORMANCE BY RESPONDENTS ON HISTOLOGY PROCEDURES

TASK	CERTIFIED SPECIALISTS %CS (n=1)	NON-CERTIFIED SPECIALISTS %NCS (n=11)	CERTIFIED GENERALISTS %CG (n=1)	NON-CERTIFIED GENERALISTS %NCG (n=3)
1. Assist in preparation of gross specimens for medical photography.	0	73	0	67
2. Assist with autopsy.	0	46	0	33
3. Decalcify specimens of teeth and bone.	0	91	0	100
4. Embed tissue in paraffin.	0	91	100	67
5. Hand-sharpen knives.	0	73	0	67
6. Log in and/or code incoming specimens.	100	91	100	100
7. Perform routine immuno-histology (e.g., fluorochrome dyes).	0	36	0	0
8. Mount tissue section in preparation for microscopic study.	100	91	100	100
9. Prepare celloidin embeddings.	0	45	0	0
10. Prepare frozen section of tissue.	0	82	0	100
11. Prepare routine stains and fixatives.	100	91	0	100
12. Prepare special stains.	100	91	0	100
13. Prepare specimens for shipment.	100	91	0	67
14. Prepare tissue for celloidin embedding and sectioning.	0	54	0	0
15. Prepare tissue for fixation, dehydration, and infiltration of paraffin.	0	91	0	100
16. Section tissue in microscopic blocks.	100	82	100	67
17. Stain Pap smears.	0	82	100	100
18. Stain specimens for microscopic study.	100	91	100	100
19. Submit tissue specimens to AFIP or histopathogy centers.	0	64	0	67

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APPENDIX L

INFORMATION SURVEY

1. Name of facility_____

2. Address of facility_____

_____

3. Type of facility (circle one letter):

   a. Hospital b. Independent Laboratory c. Nursing Home

   d. Rehabilitation Center e. Other (Specify)_____

4. Type of Laboratory (Circle one letter):

   a. General b. Speciality (specify type)_____

5. Total number of technologists, technicians, and lab aides:

   a. Full time_____

   b. Part time_____

6. Full time personnel only:

Names (Mrs., Miss, Mr., etc. First, Last)	Years Employed in this laboratory	Classification or Certification: MLT (ASCP), CT (ASCP), HT (ASCP), MT (ASCP), CLA (ASCP), MLT, etc.

APPENDIX M

Directions:

Step One: Read through the entire Task List and check (✓) all tasks that you do.

Step Two: For only those tasks checked in Step One, indicate with an "X" in the squares, the Frequency and Difficulty of the tasks.

TASK LIST	Step One: Check If Done ✓	Step Two: FREQUENCY ☒ How often do you do this task? Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	DIFFICULTY ☒ How difficult is this task? EASY Routine procedure- No decisions	Several procedures- Minor decisions	AVERAGE Select a procedure	Establish and/or Modify procedure	HARD Make complex decisions Little precedent
I. LABORATORY FUNCTIONS											
A. Performing General Medical Laboratory Tasks											
1. Assist in epidemiological investigations		1	2	3	4	5	1	2	3	4	5
2. Assist in research assignments		1	2	3	4	5	1	2	3	4	5
3. Assist with collection of serous (serum producing) cavity specimens		1	2	3	4	5	1	2	3	4	5
4. Assist with collection of spinal fluid specimens		1	2	3	4	5	1	2	3	4	5
5. Charge or code charge work done		1	2	3	4	5	1	2	3	4	5
6. Clean area and equipment aseptically		1	2	3	4	5	1	2	3	4	5
7. Collect bile specimens from the patients		1	2	3	4	5	1	2	3	4	5
8. Collect blood specimens from the patients		1	2	3	4	5	1	2	3	4	5
9. Collect fecal or urine specimens from the patients		1	2	3	4	5	1	2	3	4	5
10. Collect nose or throat specimens from the patients		1	2	3	4	5	1	2	3	4	5
11. Collect serous cavity specimens from the patients		1	2	3	4	5	1	2	3	4	5
12. Collect skin specimens from the patients		1	2	3	4	5	1	2	3	4	5
13. Collect spinal fluid specimens from the patients		1	2	3	4	5	1	2	3	4	5
14. Collect sputum specimens from the patients		1	2	3	4	5	1	2	3	4	5
15. Collect urethral or vaginal specimens from the patients		1	2	3	4	5	1	2	3	4	5
16. Collect specimens from wounds		1	2	3	4	5	1	2	3	4	5
17. Inventory and order supplies		1	2	3	4	5	1	2	3	4	5
18. Perform bacteriological or chemical examinations of food products		1	2	3	4	5	1	2	3	4	5
19. Perform bacteriological or chemical examinations of sewage		1	2	3	4	5	1	2	3	4	5

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Blank spaces are for tasks done by you but not listed.

APPENDIX N

Survey Directions

A. General Information:

1. The following task survey is divided into two main sections: I. Laboratory Functions, and II. Management Functions. Each main section is further divided into Areas lettered A, B, C, etc. These areas are further sub-divided into Individual Performance Tasks numbered 1, 2, 3, etc.

2. There are three vertical columns for your responses. They are Column 1, Do you perform this task?, Column 2, Frequency (How often do you do this task?) and Difficulty (How difficult is the task?)

B. Specific Directions (please read carefully):

1. Beginning with Column 1, Do you perform this task?, go through the entire task list and place a check (✓) next to the task that you perform, even if you perform it rarely.

2. For only the tasks you have checked in Column 1, place an "X" in one of the squares [X] in Column 2, Frequency and in one of the squares [X] in Column 3, Difficulty.

Difficulty Column (Interpretation)

First Column: EASY
Uncomplicated basic tasks requiring minimum knowledges and/or skills.

Third Column: AVERAGE
Routine tasks which require some additional knowledges and/or skills.

Last Column: HARD
Complex or non-routine tasks requiring advanced knowledges and/or skills.

APPENDIX O

MEDICAL LABORATORY TASK ANALYSIS SURVEY

Job Data

Directions:

1. For the statements followed by a blank space, write in the requested information. (see item A1)

2. For the multiple choice statements, circle the letter of the appropriate response. (see item A2)

A. Where you work

1. Name of facility _____

2. What type of facility?

   a. Tax-supported or voluntary (non-profit) hospital

   b. Proprietary hospital

   c. Extended care (nursing home, rehabilitation center, etc.)

   d. Independent laboratory

   e. Physician's office

3. How many beds in the facility? _____

4. How many licensed or certificated laboratory personnel (CLA, MT, HT, MLT, etc.) perform laboratory tasks in this facility? _____

5. How many years have you worked in this laboratory? _____

MEDICAL LABORATORY TASK ANALYSIS SURVEY

(Cont'd)

B. Personal Information

1. Age _____ Sex _____ Marital Status _____

2. Years worked in laboratories _____

3. Year training was completed _____

4. Certification or classification (circle one or more):

a. CLA (ASCP) d. MLT (ASCP) g. Other (specify) _____

b. HT (ASCP) e. MT (ASCP) h. None

c. CT (ASCP) f. MT (Calif.)

5. Years of school completed (circle highest number):

a. 8 or less

b. 9 - 12

c. 13

d. 14

e. 15 - 16

f. more than 16

6. Highest diploma or degree held:

a. Less than high school diploma

b. High school diploma

c. Associate degree

d. Bachelor's degree (Major subject) _____

e. Master's degree (Major subject) _____

f. Doctorate degree (Major subject) _____

g. Other (specify) _____

C O N F I D E N T I A L D O C U M E N T

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MEDICAL LABORATORY TASK ANALYSIS SURVEY

(Cont'd)

7. Type(s) of medical laboratory training you have had (circle all categories that apply)

   a. None

   b. On the job

   c. Military

   d. Manufacturer's course

   e. Vocational school

   f. College or university

   g. Other (specify) _____

8. Your major responsibilities (circle one or more)

   a. Bacteriology

   b. Biochemistry

   c. Blood Bank

   d. Hematology

   e. Serology

   f. Urinalysis

   g. General (rotate continuously through any 5 of the above)

   h. Cytotechnology

   i. Histology

   j. Supervisor

   k. Research

   l. Other (specify type) _____

9. Yearly salary range

   a. Less than 5,000 c. 8,000 - 10,999 e. 14,000 - 16,999

   b. 5,000 - 7,999 d. 11,000 - 13,999 f. 17,000 - or more

C O N F I D E N T I A L D O C U M E N T

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APPENDIX P

LIST OF HEALTH CARE FACILITIES SELECTED FOR NATIONAL SURVEY

BIRMINGHAM

200 Beds or More	Baroness Erlanger Hospital	Chattanooga, Tennessee
	*Baptist Medical Center Montclair	Birmingham, Alabama
100-199 Beds	*Jeff Anderson Memorial Hospital	Meridian, Mississippi
	Saint Judes Catholic Hospital	Montgomery, Alabama
Under 100 Beds	*Athens-Limestone Hospital	Athens, Alabama
	Sam Howell Memorial Hospital	Cartersville, Georgia
Extended Care Facility	Plantation Manor	McCalla, Alabama
	Saint Lukes Nursing Home	Birmingham, Alabama
Independent Laboratory	Medical Laboratory Associates	Birmingham, Alabama

BOSTON

200 Beds or More	Memorial Hospital	Worcester, Massachusetts
	Peter Bent Brigham Hospital	Boston, Massachusetts
100-199 Beds	*Faulkner Hospital	Boston, Massachusetts
	*Thayer Hospital	Waterville, Maine
Under 100 Beds	*Falmouth Hospital	Falmouth, Massachusetts
	*Mary Lane Hospital	Ware, Massachusetts
Extended Care Facility	Cambridge Nursing Home	Cambridge, Massachusetts
	Hebrew Rehabilitation Center for the Aged	Boston, Massachusetts

CHICAGO

200 Beds or More	Chicago Wesley Memorial Hospital	Chicago, Illinois
	Memorial Hospital	Kenosha, Wisconsin
100-199 Beds	*Beloit Memorial Hospital	Beloit, Wisconsin
	*Delnor Hospital	St. Charles, Illinois
Under 100 Beds	*Bethany Brethren Hospital	Chicago, Illinois
	DeKalb Public Hospital	DeKalb, Illinois

*Medical Laboratory survey responses received from one or more employees.

CHICAGO

Extended Care Facility	Fox River Rehabilitation Center	Chicago, Illinois
	Hearthside Nursing Home	Chicago, Illinois

DENVER

200 Beds or More	Saint Lukes Hospital	Denver, Colorado
	*Saint Marys Hospital	Grand Junction, Colorado
100-199 Beds	*Memorial Hospital of Laramie County	Cheyenne, Wyoming
	Poudre Valley Memorial Hospital	Fort Collins, Colorado
Under 100 Beds	*Alamosa County Hospital	Alamosa, Colorado
	*Longmont Community Hospital	Longmont, Colorado
Extended Care Facility	Eventide Nursing Home	Longmont, Colorado
	Ivy Manor Nursing Home	Denver, Colorado
Independent Laboratories	Pathology Consultant Laboratory	Denver, Colorado

LOS ANGELES

200 Beds or More	*Camarillo State Hospital	Camarillo, California
	Kaiser Foundation Hospital	Panorama City, California
	*Memorial Hospital of Southern California	Culver City, California
	Santa Monica Hospital	Santa Monica, California
	Veterans Administration Hospital	Los Angeles, California
100-199 Beds	*Morningside Hospital	Los Angeles, California
	*West Valley Community Hospital	Encino, California
Under 100 Beds	Community Hospital of Gardena	Gardena, California
	*Garden Park General Hospital	Anaheim, California
	Sunset Boulevard Hospital	Los Angeles, California
Extended Care Facility	Culver City Convalescent Hospital	Los Angeles, California
	Kaiser Extended Care Facility	Panorama City, California

*Medical Laboratory survey responses received from one or more employees.

LOS ANGELES

Independent Laboratories	*Bio-Science Laboratories	Van Nuys, California
	*Laboratory Associates	Los Angeles, California

SEATTLE

200 Beds or More	*Emmanuel Hospital	Portland, Oregon
	*Saint Francis Xavier Cabrini Hospital	Seattle, Washington
100-199 Beds	*Saint Josephs Hospital	Aberdeen, Washington
	*Vancouver Memorial Hospital	Vancouver, Washington
Under 100 Beds	Tri-State Memorial Hospital	Clarkston, Washington
	*West Seattle General Hospital	Seattle, Washington
Extended Care Facility	L. C. Foss Sunset House	Seattle, Washington
	Mount Baker Convalescent Home	Seattle, Washington
Independent Laboratories	*Pathologists Central Laboratory	Seattle, Washington

*Medical Laboratory survey responses received from one or more employees.

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	EASY Routine procedure- No decisions	Several procedures- Minor decisions	AVERAGE Select Suitable procedure	Establish and/or Modify procedure	HARD Make complex decisions- Little precedent
I. LABORATORY FUNCTIONS											
A. Performing General Medical Laboratory Tasks											
1. Assist in epidemiological investigations	15	1	2	3	4	☒	☒	2	3	4	5
2. Assist in research assignments	34	1	2	3	☒	5	1	2	3	4	☒
3. Assist with collection of serous (serum producing) cavity specimens	9	1	2	3	4	☒	☒	2	3	4	5
4. Assist with collection of spinal fluid specimens	7	1	2	3	4	☒	1	2	☒	4	5
5. Charge or code charge work done	45	☒	2	3	4	5	☒	2	3	4	5
6. Clean area and equipment aseptically	53	☒	2	3	4	5	☒	2	3	4	5
7. Collect bile specimens from the patients	8	1	2	3	4	☒	☒	2	3	4	5
8. Collect blood specimens from the patients	67	☒	2	3	4	5	☒	2	3	4	5
9. Collect fecal or urine specimens from the patients	33	☒	2	3	4	5	☒	2	3	4	5
10. Collect nose or throat specimens from the patients	41	1	2	☒	4	5	☒	2	3	4	5
11. Collect serous cavity specimens from the patients	8	1	2	3	4	☒	☒	2	3	4	5
12. Collect skin specimens from the patients	19	1	2	3	☒	5	☒	2	3	4	5
13. Collect spinal fluid specimens from the patients	5	1	2	3	4	☒	☒	2	3	4	5
14. Collect sputum specimens from the patients	27	1	2	3	☒	5	☒	2	3	4	5
15. Collect urethral or vaginal specimens from the patients	13	1	2	3	4	☒	☒	2	3	4	5
16. Collect specimens from wounds	24	1	2	3	4	☒	☒	2	3	4	5
17. Inventory and order supplies	64	1	2	☒	4	5	☒	2	3	4	5
18. Perform bacteriological or chemical examinations of food products	18	1	2	3	4	☒	☒	2	3	4	5
19. Perform bacteriological or chemical examinations of sewage	9	1	2	3	4	☒	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

A. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
20. Perform bacteriological or chemical examinations of water	18	1	2	3	☒	5	1	2	☒	4	5
21. Perform Basal Metabolism Rate (BMR) tests	15	1	2	3	4	☒	1	2	☒	4	5
22. Perform electrocardiogram (EKG) tests	33	1	2	3	4	☒	☒	2	3	4	5
23. Perform preventive maintenance on laboratory equipment	49	1	2	☒	4	5	1	2	☒	4	5
24. Perform sperm counts	36	1	2	3	4	☒	1	2	☒	4	5
25. Prepare and process specimens	64	☒	2	3	4	5	☒	2	3	4	5
26. Prepare electrophoresis patterns	24	1	2	3	☒	5	1	☒	3	4	5
27. Prepare reagents	78	1	☒	3	4	5	☒	2	3	4	5
28. Prepare specimens for electron microscopy	7	1	2	3	4	☒	☒	2	3	4	5
29. Prepare specimens for shipment	51	1	2	3	☒	5	☒	2	3	4	5
30. Prepare specimens for training or reference	38	1	2	☒	4	5	1	2	☒	4	5
31. Prepare standards	61	1	2	☒	4	5	1	2	☒	4	5
32. Read electrophoresis patterns	17	1	2	3	4	☒	1	2	☒	4	5
33. Write technical papers for publication	11	1	2	3	4	☒	1	2	3	4	☒
		1	2	3	4	5	1	2	3	4	5
B. Preparing Medical Illustration Materials											
1. Collect and assemble medical illustration material	16	1	2	3	☒	5	1	2	3	4	☒
2. Distribute medical illustration material	9	1	2	3	☒	5	1	2	☒	4	5
3. Draft and prepare illustrations	8	1	2	3	☒	5	1	2	☒	4	5
4. Duplicate illustrated materials	13	1	2	3	☒	5	☒	2	3	4	5
5. Maintain reference file of illustrations	15	1	2	3	☒	5	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
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C. Utilizing Laboratory Equipment											
1. Operate automatic analyzers	34	☒	2	3	4	5	1	2	☒	4	5
a. Continuous flow--dual channel	25	1	2	☒	4	5	1	2	☒	4	5
b. Continuous flow--single channel	24	☒	2	3	4	5	1	☒	3	4	5
c. Continuous flow--SMA 4 (hematology)	8	1	2	3	4	☒	1	2	☒	4	5
d. Continuous flow--SMA 6	3	☒	2	3	4	5	1	☒	3	4	5
e. Continuous flow--SMA 7 (hematology)	3	1	2	3	4	☒	1	2	☒	4	5
f. Continuous flow--SMA 12-30	6	1	2	3	4	☒	1	2	☒	4	5
g. Continuous flow--SMA 12-60	8	1	2	3	4	☒	1	2	☒	4	5
h. Continuous flow--other	7	☒	2	3	4	5	☒	2	3	4	5
i. Discrete sample--Beckman DSA	4	☒	2	3	4	5	1	☒	3	4	5
j. Discrete sample--B & L Enzymat	4	1	2	3	4	☒	☒	2	3	4	5
k. Discrete sample--Clino-Mak-Labline	3	1	2	3	4	☒	☒	2	3	4	5
l. Discrete sample--Dupont ACA	3	1	2	3	4	☒	☒	2	3	4	5
m. Discrete sample--Hycel Mark-10	3	1	2	3	4	☒	☒	2	3	4	5
n. Discrete sample--Robot Chemist	5	1	2	3	4	☒	☒	2	3	4	5
o. Discrete sample--other	4	1	2	3	4	☒	☒	2	3	4	5
2. Operate automatic cell counter	28	☒	2	3	4	5	☒	2	3	4	5
a. Coulter - multi-channel, Model S	14	☒	2	3	4	5	1	☒	3	4	5
b. Coulter - single channel	29	☒	2	3	4	5	☒	2	3	4	5
c. Coulter - other	11	☒	2	3	4	5	☒	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

C. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
3. Operate balance--analytical	64	1	2	3	☒	5	☒	2	3	4	5
a. Weighing to nearest milligram	58	1	2	☒	4	5	☒	2	3	4	5
b. Weighing to nearest 0.1 milligram or less	50	1	2	☒	4	5	☒	2	3	4	5
4. Operate Basal Metabolism apparatus	11	1	2	3	4	☒	☒	2	3	4	5
5. Operate blood gas apparatus	31	1	2	☒	4	5	1	2	☒	4	5
a. Manometric	19	1	2	☒	4	5	1	2	☒	4	5
b. Volumetric	14	1	2	3	4	☒	☒	2	3	4	5
6. Operate chloridometer	26	1	2	☒	4	5	☒	2	3	4	5
7. Operate chromatograph equipment	10	1	2	3	4	☒	1	☒	3	4	5
a. Gas	7	1	2	3	4	☒	1	☒	3	4	5
b. Glass filter type	4	1	2	3	4	☒	☒	2	3	4	5
c. Interference filter type	3	1	2	3	4	☒	☒	2	3	4	5
d. Paper	10	1	2	3	4	☒	☒	2	3	4	5
e. Thin layer	8	1	2	3	☒	5	☒	2	3	4	5
8. Operate colorimeter	45	☒	2	3	4	5	☒	2	3	4	5
9. Operate differential cell counter	32	☒	2	3	4	5	☒	2	3	4	5
10. Operate distillation apparatus	25	1	2	3	4	☒	☒	2	3	4	5
11. Operate electrophoresis equipment	23	1	2	3	☒	5	1	☒	3	4	5
a. Agarose or agar systems	10	1	2	☒	4	5	1	☒	3	4	5
b. Cellulose acetate system	16	1	2	3	☒	5	1	2	☒	4	5
c. Paper system	6	1	2	3	4	☒	☒	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

C. (cont.)

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
12. Operate electrocardiograph	28	☒	2	3	4	5	☒	2	3	4	5
13. Operate flame photometer	46	☒	2	3	4	5	☒	2	3	4	5
a. Regular	35	1	2	☒	4	5	☒	2	3	4	5
b. Atomic absorption (with hollow cathode and chopper)	7	1	2	3	4	☒	1	2	☒	4	5
14. Operate fluorometer	20	1	2	3	☒	5	1	2	☒	4	5
15. Operate hemoglobinometer	32	☒	2	3	4	5	☒	2	3	4	5
16. Operate microhematocrit reader	50	☒	2	3	4	5	☒	2	3	4	5
17. Operate microtone	12	☒	2	3	4	5	☒	2	3	4	5
18. Operate osmometer	11	1	2	3	4	☒	☒	2	3	4	5
19. Operate pH meter	51	1	2	☒	4	5	☒	2	3	4	5
20. Operate reflection oximeter	3	1	2	3	4	☒	☒	2	3	4	5
21. Operate spectrophotometer	50	☒	2	3	4	5	☒	2	3	4	5
a. Visible range	47	☒	2	3	4	5	☒	2	3	4	5
b. Ultra violet	31	☒	2	3	4	5	☒	2	3	4	5
c. Infra red	16	☒	2	3	4	5	☒	2	3	4	5
22. Use ashing oven	10	1	2	3	4	☒	☒	2	3	4	5
23. Use blood bank--alarm system	24	☒	2	3	4	5	☒	2	3	4	5
24. Use blood bank--freezer	13	☒	2	3	4	5	☒	2	3	4	5
25. Use blood bank--refrigerator	38	☒	2	3	4	5	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

C. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
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26. Use centrifuge--general laboratory	88	☒	2	3	4	5	☒	2	3	4	5
27. Use centrifuge--microhematocrit	57	☒	2	3	4	5	☒	2	3	4	5
28. Use centrifuge--ultracentrifuge	5	☒	2	3	4	5	☒	2	3	4	5
29. Use extraction apparatus--separatory funnel	36	1	2	3	☒	5	☒	2	3	4	5
30. Use extraction or chromatographic apparatus--Sephadex or resin column	14	1	☒	3	4	5	☒	2	3	4	5
31. Use heating blocks	44	☒	2	3	4	5	☒	2	3	4	5
32. Use incubator--aerobic	50	☒	2	3	4	5	☒	2	3	4	5
33. Use incubator--anaerobic	28	☒	2	3	4	5	☒	2	3	4	5
34. Use microburettes	16	1	2	3	4	☒	☒	2	3	4	5
35. Use microscopes	72	☒	2	3	4	5	☒	2	3	4	5
a. Light bright field	56	☒	2	3	4	5	☒	2	3	4	5
b. Light dark field	19	1	2	3	☒	5	☒	2	3	4	5
c. Phase contrast	8	1	2	3	4	☒	1	2	3	4	☒
d. Interference	3	1	2	3	4	☒	1	2	☒	4	5
e. Fluorescence	10	1	2	3	4	☒	1	2	☒	4	5
f. Polarizing	6	1	2	3	4	☒	1	2	☒	4	5
g. Electron	4	1	2	3	4	☒	1	2	3	4	☒
36. Use pipette--automatic	51	☒	2	3	4	5	☒	2	3	4	5
37. Use pipette--semi-automatic	46	☒	2	3	4	5	☒	2	3	4	5
38. Use pipette--manual	86	☒	2	3	4	5	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

C. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
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39. Use pipette--macro 0.1 or larger	80	☒	2	3	4	5	☒	2	3	4	5
40. Use pipette--micro less than 0.1 ml.	65	☒	2	3	4	5	☒	2	3	4	5
41. Use pipette--to deliver	79	☒	2	3	4	5	☒	2	3	4	5
42. Use pipette--to contain	71	☒	2	3	4	5	☒	2	3	4	5
43. Use sterilizer--autoclave	34	☒	2	3	4	5	☒	2	3	4	5
44. Use sterilizer--gas (e.g., ethylene oxide with CO_2)	2	1	2	3	4	☒	☒	2	3	4	5
45. Use tissue processing apparatus--automatic	12	☒	2	3	4	5	☒	2	3	4	5
46. Use titrators	34	☒	2	3	4	5	☒	2	3	4	5
a. Automatic end point	9	☒	2	3	4	5	☒	2	3	4	5
b. Burette	29	1	2	☒	4	5	☒	2	3	4	5
c. Electrometric end point	10	☒	2	3	4	5	☒	2	3	4	5
d. Visual end point	31	1	2	☒	4	5	☒	2	3	4	5
47. Use waterbaths	76	☒	2	3	4	5	☒	2	3	4	5
48. Use radioisotope measurement instruments	21	☒	2	3	4	5	☒	2	3	4	5
a. Operate scintillation camera	5	1	2	3	4	☒	☒	2	3	4	5
b. Operate scanner	8	1	2	3	4	☒	1	☒	3	4	5
c. Use liquid scintillation system	6	1	2	3	4	☒	☒	2	3	4	5
d. Use manual cell counting equipment	20	1	2	3	4	☒	☒	2	3	4	5
(1) T-3 type or T-4 type measurement system	16	☒	2	3	4	5	☒	2	3	4	5
e. Use probe-uptake counting equipment (e.g., I-131 thyroid uptake)	8	1	2	3	☒	5	1	2	☒	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

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PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

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D. Performing Bacteriological Procedures											
1. Examine specimens microscopically	49	☒	2	3	4	5	1	2	☒	4	5
2. Identify and classify pathogenic bacteria	38	☒	2	3	4	5	1	2	☒	4	5
3. Inoculate tubed media	46	☒	2	3	4	5	☒	2	3	4	5
4. Maintain stock cultures	20	1	2	☒	4	5	☒	2	3	4	5
5. Operate anaerobic devices	32	1	2	3	☒	5	☒	2	3	4	5
6. Perform animal inoculations	7	1	2	3	4	☒	1	2	☒	4	5
7. Perform animal virulence tests	3	1	2	3	4	☒	☒	2	3	4	5
8. Perform antibiotic and antimicrobial agent sensitivity tests	37	☒	2	3	4	5	☒	2	3	4	5
9. Perform fluorescent antibody studies	7	1	2	3	4	☒	1	2	☒	4	5
10. Prepare autogenous vaccines	8	1	2	3	4	☒	1	2	☒	4	5
11. Prepare culture media	36	1	2	☒	4	5	☒	2	3	4	5
12. Prepare subculture and smears	38	☒	2	3	4	5	1	2	☒	4	5
13. Receive and primary process all cultures <u>except</u> blood, T. B., and fungus	38	☒	2	3	4	5	☒	2	3	4	5
14. Receive and process T. B. cultures	31	1	2	☒	4	5	1	2	☒	4	5
15. Receive and process blood cultures	42	1	2	☒	4	5	☒	2	3	4	5
16. Record and/or report colony counts on urine	36	☒	2	3	4	5	☒	2	3	4	5
17. Record and/or report colony counts on other than urine	15	1	2	☒	4	5	1	2	☒	4	5
18. Stain bacteriological smears	50	☒	2	3	4	5	☒	2	3	4	5
19. Streak plates	52	☒	2	3	4	5	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

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E. Performing Mycology Procedures											
1. Cultivate mycology specimens for primary isolation	29	1	2	3	☒	5	1	2	☒	4	5
2. Examine mycology specimens microscopically	28	1	2	3	☒	5	1	2	☒	4	5
3. Identify and classify fungi	23	1	2	3	4	☒	1	2	3	4	☒
4. Perform KOH preparation for dermatophytes	22	1	2	3	☒	5	1	2	☒	4	5
5. Prepare culture media	28	1	2	3	☒	5	☒	2	3	4	5
6. Stain mycology specimens	25	1	2	3	☒	5	1	2	☒	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
F. Performing Parasitology Procedures											
1. Examine specimens macroscopically	39	1	2	3	☒	5	1	2	☒	4	5
2. Examine specimens microscopically	42	1	2	3	☒	5	1	2	☒	4	5
3. Identify parasitic and disease-carrying arthropods	23	1	2	3	☒	5	1	2	☒	4	5
4. Identify protozoans, cestodes, nematodes, and trematodes	29	1	2	3	☒	5	1	2	☒	4	5
5. Maintain parasite cultures	4	1	2	3	4	☒	☒	2	3	4	5
6. Perform concentration and flotation techniques	35	1	2	3	☒	5	1	2	☒	4	5
7. Perform microfilarial examinations	12	1	2	3	4	☒	1	2	☒	4	5
8. Perform serological tests for parasites (e.g., trichinosis)	8	1	2	3	4	☒	1	☒	3	4	5
9. Stain parasitological smears	25	1	2	3	☒	5	1	2	☒	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

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G. Performing Serology Procedures											
1. Identify viruses and/or rickettsia	2	1	2	3	4	☒	☒	2	3	4	5
2. Perform antistreptolysin "O" titers	36	1	2	☒	4	5	1	2	☒	4	5
3. Perform cardiolipin microflocculation test	18	1	2	3	☒	5	1	2	☒	4	5
4. Perform colloidal gold test	23	1	2	3	☒	5	☒	2	3	4	5
5. Perform complement fixation tests	17	1	2	3	4	☒	1	2	☒	4	5
6. Perform "C" reactive protein tests	29	1	2	3	☒	5	☒	2	3	4	5
7. Perform febrile agglutination (e.g., salmonella) tests	39	1	2	3	☒	5	1	2	☒	4	5
8. Perform fluorescent treponemal antibody test	3	1	2	3	4	☒	1	2	3	☒	5
9. Perform hemagglutination inhibition test	10	1	2	3	4	☒	1	2	☒	4	5
10. Perform heterophile presumptive test	39	1	2	3	☒	5	☒	2	3	4	5
11. Perform infectious mononucleosis procedures - monospot or monotest	41	1	2	3	☒	5	☒	2	3	4	5
12. Perform latex fixation test	38	1	2	3	☒	5	☒	2	3	4	5
13. Perform rheumatoid arthritis test (RA)	41	1	2	3	☒	5	☒	2	3	4	5
14. Perform and read fluorescent antigen-antibody tests	7	1	2	3	☒	5	1	2	☒	4	5
15. Perform skin tests	16	1	2	3	4	☒	☒	2	3	4	5
16. Read skin tests	15	1	2	3	4	☒	1	2	☒	4	5
17. Perform and read agglutination tests (e.g., cold agglutinations)	38	1	2	3	☒	5	1	2	☒	4	5
18. Perform and read flocculation tests (other than serological tests for syphilis)	23	1	2	3	☒	5	1	2	☒	4	5
19. Perform and read precipitation reactions (e.g., agar gel immunodiffusion)	6	1	2	3	4	☒	1	☒	3	4	5
20. Perform strep MG test	3	1	2	3	4	☒	☒	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

G. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
21. Perform thyroid antibody test	7	1	2	3	4	☒	☒	2	3	4	5
22. Perform VDRL test	38	1	2	3	☒	5	☒	2	3	4	5
23. Perform other serological tests for syphilis	16	1	2	3	4	☒	☒	2	3	4	5
24. Prepare antigens	25	1	2	☒	4	5	☒	2	3	4	5
25. Prepare and read hemolysin reactions	16	1	2	☒	4	5	1	2	☒	4	5
26. Prepare specimens for virus isolation	5	1	2	3	4	☒	1	☒	3	4	5
		1	2	3	4	5	1	2	3	4	5
H. Performing Hematology Procedures											
1. Perform bleeding time procedures	49	1	2	☒	4	5	☒	2	3	4	5
2. Prepare and stain blood smears	58	☒	2	3	4	5	☒	2	3	4	5
3. Perform bone marrow examinations on specimens	15	1	2	3	4	☒	1	2	☒	4	5
4. Perform capillary resistance test	21	1	2	3	4	☒	☒	2	3	4	5
5. Perform chromosomal analysis	4	1	2	3	4	☒	1	2	☒	4	5
6. Perform clot retraction test	46	1	2	3	☒	5	☒	2	3	4	5
7. Perform venous whole blood coagulation time tests	50	1	2	☒	4	5	☒	2	3	4	5
8. Perform cryoglobulin tests	16	1	2	3	4	☒	☒	2	3	4	5
9. Perform differential cell counts	54	☒	2	3	4	5	1	2	☒	4	5
10. Perform eosinophile count	44	1	2	3	☒	5	☒	2	3	4	5
11. Perform erythrocyte fragility tests	34	1	2	3	4	☒	1	2	☒	4	5
12. Calculate erythrocyte indices	47	1	2	☒	4	5	☒	2	3	4	5
13. Perform factor V - VIII - X assays	16	1	2	3	4	☒	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

H. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure- No decisions	Several procedures- Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
14. Perform fibrinogen deficiency test	34	1	2	3	☒	5	1	2	☒	4	5
15. Perform fibrinolysin tests	23	1	2	3	4	☒	1	2	☒	4	5
16. Perform hematocrit tests	58	☒	2	3	4	5	☒	2	3	4	5
17. Perform hemoglobin tests	58	☒	2	3	4	5	☒	2	3	4	5
18. Prepare lupus erythematosus (L.E.) slides	46	1	2	☒	4	5	☒	2	3	4	5
19. Microscopically identify L.E. cells	38	1	2	3	☒	5	1	2	☒	4	5
20. Stain and read malaria smears	40	1	2	3	4	☒	1	2	☒	4	5
21. Identify morphological variations of red or white blood cells	51	☒	2	3	4	5	1	2	☒	4	5
22. Perform partial thromboplastin time (PTT) test	44	1	2	☒	4	5	1	2	☒	4	5
23. Stain and read peroxidase stain	18	1	2	3	4	☒	1	2	☒	4	5
24. Perform platelet count	52	1	2	☒	4	5	1	2	☒	4	5
25. Perform prothrombin consumption test	26	1	2	3	4	☒	1	2	☒	4	5
26. Perform prothrombin time test	53	☒	2	3	4	5	☒	2	3	4	5
27. Perform red blood count	53	1	2	☒	4	5	☒	2	3	4	5
28. Perform reticulocyte cell count	49	1	2	☒	4	5	☒	2	3	4	5
29. Perform erythrocyte sedimentation rate	54	☒	2	3	4	5	☒	2	3	4	5
30. Perform sickle cell preparations	40	1	2	3	☒	5	1	2	☒	4	5
31. Perform spinal fluid cell counts	50	1	2	☒	4	5	1	2	☒	4	5
32. Perform thromboplastin generation tests	19	1	2	3	4	☒	1	2	☒	4	5
33. Perform white blood count	57	☒	2	3	4	5	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure- No decisions	Several procedures- Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
I. Performing Urinalyses Procedures											
1. Examine urine specimens macroscopically	60	☒	2	3	4	5	☒	2	3	4	5
2. Examine urine specimens microscopically	58	☒	2	3	4	5	☒	2	3	4	5
3. Perform acetone or ketone tests	57	☒	2	3	4	5	☒	2	3	4	5
4. Perform Addis counts	30	1	2	3	4	☒	1	2	☒	4	5
5. Perform Bence-Jones protein tests	47	1	2	3	☒	5	1	2	☒	4	5
6. Perform bile tests	51	1	2	☒	4	5	☒	2	3	4	5
7. Perform bilirubin tests	44	1	2	☒	4	5	☒	2	3	4	5
8. Perform concentration test (e.g., Fishberg)	23	1	2	3	4	☒	☒	2	3	4	5
9. Perform concentration-dilution tests (e.g., Mosenthal)	20	1	2	3	4	☒	☒	2	3	4	5
10. Perform true glucose tests	50	☒	2	3	4	5	☒	2	3	4	5
11. Perform urine hemoglobin (blood) test	47	☒	2	3	4	5	☒	2	3	4	5
12. Perform hemosiderin tests	10	1	2	3	4	☒	1	2	☒	4	5
13. Perform microscopic test for lipids (fats)	20	1	2	3	4	☒	1	2	☒	4	5
14. Perform pH tests	57	☒	2	3	4	5	☒	2	3	4	5
15. Perform phenylpyruvic acid tests	16	1	2	3	4	☒	☒	2	3	4	5
16. Perform pitressin response concentration tests	2	1	2	3	4	☒	☒	2	3	4	5
17. Perform porphyrins tests	33	1	2	3	☒	5	1	2	☒	4	5
18. Perform pregnancy tests	47	1	2	☒	4	5	☒	2	3	4	5
19. Perform qualitative urine protein tests	53	☒	2	3	4	5	☒	2	3	4	5
20. Perform urine reducing substance	29	☒	2	3	4	5	☒	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

I. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure- No decisions	Several procedures- Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions- Little precedent
21. Perform specific gravity tests	60	☒	2	3	4	5	☒	2	3	4	5
22. Perform toxicological tests (e.g., lead)	18	1	2	3	4	☒	1	2	☒	4	5
23. Perform urobilinogin tests	42	1	2	3	☒	5	1	2	☒	4	5
24. Perform water loading test (e.g., Soffer)	3	1	2	3	4	☒	1	☒	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
J. Performing Radioactivity Detection Procedures											
1. Assist in preparing and counting samples	14	1	2	3	☒	5	1	2	☒	4	5
2. Conduct tests for presence and measurement of radioactivity	11	1	2	3	4	☒	☒	2	3	4	5
3. Count body fluid specimens	9	1	2	3	☒	5	1	2	☒	4	5
4. Dispose of radioactive wastes	12	1	2	☒	4	5	☒	2	3	4	5
5. Maintain safety standards	12	☒	2	3	4	5	☒	2	3	4	5
6. Modify standard laboratory equipment and techniques to measure radioactivity	6	1	2	3	4	☒	1	2	☒	4	5
7. Perform organ scans and/or images	5	1	2	3	4	☒	1	2	3	☒	5
8. Perform autoradiography	3	1	2	3	4	☒	☒	2	3	4	5
9. Record and summarize data	6	☒	2	3	4	5	1	2	☒	4	5
10. Segregate and prepare radioactive specimens for measurement of radioactivity	7	1	2	3	4	☒	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
K. Performing Biochemistry Procedures											
1. Perform acid gel reaction test	4	1	2	3	4	☒	☒	2	3	4	5
2. Perform acid phosphatase test	50	1	2	3	☒	5	☒	2	3	4	5
3. Perform serum albumin tests	48	1	2	☒	4	5	☒	2	3	4	5
4. Perform A/G Ratio	46	1	2	☒	4	5	☒	2	3	4	5
5. Perform blood alcohol tests	24	1	2	3	4	☒	1	2	☒	4	5
6. Perform alkaline phosphatase test	53	1	2	☒	4	5	☒	2	3	4	5
7. Perform alkaloids test	9	☒	2	3	4	5	☒	2	3	4	5
8. Perform amylase test	55	1	2	☒	4	5	☒	2	3	4	5
9. Perform barbiturate level test	32	1	2	☒	4	5	1	2	☒	4	5
10. Perform bilirubin (direct) test	56	1	2	☒	4	5	☒	2	3	4	5
11. Perform bilirubin (indirect) test	55	1	2	☒	4	5	☒	2	3	4	5
12. Perform bromosulphalein retention (BSP) tests	47	1	2	3	☒	5	☒	2	3	4	5
13. Perform calcium tests	50	1	2	☒	4	5	☒	2	3	4	5
14. Perform calculus analyses tests	21	1	2	3	4	☒	1	2	☒	4	5
15. Perform carbon dioxide determinations	49	☒	2	3	4	5	☒	2	3	4	5
16. Perform carbon monoxide determinations	24	1	2	3	4	☒	1	2	☒	4	5
17. Perform catecholamine tests	16	1	2	3	4	☒	☒	2	3	4	5
18. Perform cephalin flocculations	48	1	2	☒	4	5	☒	2	3	4	5
19. Perform chlorides tests	51	☒	2	3	4	5	☒	2	3	4	5
20. Perform total cholesterol tests	47	1	2	☒	4	5	☒	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

K. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure- No decisions	Several procedures- Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
21. Perform total cholesterol esters tests	20	1	2	☒	4	5	☒	2	3	4	5
22. Perform colloidal gold curve tests	22	1	2	3	4	☒	1	☒	3	4	5
23. Perform steroid studies	9	☒	2	3	4	5	1	2	☒	4	5
24. Perform creatine tests	33	1	2	☒	4	5	☒	2	3	4	5
25. Perform creatine phosphokinase (CPK) tests	38	1	2	☒	4	5	☒	2	3	4	5
26. Perform serum creatinine tests	50	1	2	☒	4	5	☒	2	3	4	5
27. Perform creatinine clearance tests	29	1	2	3	☒	5	1	2	☒	4	5
28. Perform enzyme analysis tests	42	☒	2	3	4	5	1	2	☒	4	5
29. Perform gastric analysis tests (e.g., acidity or Diagnex Blue)	44	1	2	☒	4	5	1	2	☒	4	5
30. Perform glucose tests	56	☒	2	3	4	5	☒	2	3	4	5
31. Perform Glucose -6- Phosphate dehydrogenase tests	13	1	2	3	4	☒	1	2	☒	4	5
32. Perform glucose tolerance tests	50	1	2	☒	4	5	☒	2	3	4	5
33. Perform serum glutamic oxalacetic transaminase (SGOT) test	53	☒	2	3	4	5	☒	2	3	4	5
34. Perform serum glutamic pyruvic transaminase (SGPT) Test	45	1	2	☒	4	5	☒	2	3	4	5
35. Perform hormonal steroid assays	10	1	2	3	4	☒	1	2	☒	4	5
36. Perform icterus index tests	37	1	2	3	4	☒	☒	2	3	4	5
37. Perform insulin tolerance tests	18	1	2	3	4	☒	☒	2	3	4	5
38. Perform lactic dehydrogenase (LDH) tests	52	☒	2	3	4	5	☒	2	3	4	5
39. Perform Leucine amino-peptidase (LAP) tests	12	1	2	☒	4	5	☒	2	3	4	5
40. Perform lipase tests	36	1	2	☒	4	5	1	2	☒	4	5
41. Perform lipids profile tests	14	1	2	3	4	☒	☒	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

K. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost daily	Several times a week	Several times a Month	Several times a Year	Almost never	Routine procedure- No decisions	Several procedures- Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
42. Perform serum magnesium tests	14	1	2	3	4	☒	☒	2	3	4	5
43. Perform non-protein nitrogen (NPN) tests	13	1	2	3	4	☒	☒	2	3	4	5
44. Perform blood oxygen tests	25	1	2	☒	4	5	1	2	☒	4	5
45. Perform blood pH tests	33	1	2	☒	4	5	1	2	☒	4	5
46. Perform phenosulfonphthalein (PSP) excretion test	36	1	2	3	☒	5	☒	2	3	4	5
47. Perform phosphorus tests	46	1	2	☒	4	5	☒	2	3	4	5
48. Perform potassium determinations	53	☒	2	3	4	5	☒	2	3	4	5
49. Perform urine prophyrin and/ or porphobilirogen tests	34	1	2	3	☒	5	1	2	☒	4	5
50. Perform frog test for pregnancy	7	1	2	3	4	☒	☒	2	3	4	5
51. Perform slide or tube test for pregnancy	45	1	2	☒	4	5	☒	2	3	4	5
52. Perform protein bound iodine (PBI) tests	15	1	2	☒	4	5	1	2	☒	4	5
53. Perform total protein tests	47	1	2	☒	4	5	☒	2	3	4	5
54. Perform salicylate level tests	42	1	2	3	☒	5	1	2	☒	4	5
55. Perform sodium determinations	50	☒	2	3	4	5	☒	2	3	4	5
56. Perform thymol turbidity tests	45	1	2	3	☒	5	☒	2	3	4	5
57. Perform tolbutamide (orinase) tolerance tests	14	1	2	3	4	☒	1	2	☒	4	5
58. Perform blood urea nitrogen (BUN) tests	52	☒	2	3	4	5	☒	2	3	4	5
59. Perform quantitative urine chemistry tests for any of the serum or blood chemistry tests previously listed (e.g., urine amylase)	42	1	2	☒	4	5	1	2	☒	4	5
60. Perform vitamin assays	9	1	2	3	☒	5	☒	2	3	4	5
61. Perform xylose tolerance tests	23	1	2	3	4	☒	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
L. Performing Histology Procedures											
1. Assist in preparation of gross specimens for medical photography	13	1	2	3	4	☒	☒	2	3	4	5
2. Assist with autopsy	10	1	2	3	4	☒	☒	2	3	4	5
3. Decalcify specimens of teeth and bone	11	1	2	☒	4	5	☒	2	3	4	5
4. Embed tissue in paraffin	15	☒	2	3	4	5	☒	2	3	4	5
5. Hand-sharpen knives	8	1	2	3	4	☒	1	2	☒	4	5
6. Log in and/or code incoming specimens	20	☒	2	3	4	5	☒	2	3	4	5
7. Perform routine immuno-histology (e.g., fluorochrome dyes)	5	1	2	3	4	☒	☒	2	3	4	5
8. Mount tissue section in preparation for microscopic study	16	☒	2	3	4	5	☒	2	3	4	5
9. Prepare celloidin embeddings	5	1	2	3	4	☒	☒	2	3	4	5
10. Prepare frozen section of tissue	11	1	2	3	4	☒	☒	2	3	4	5
11. Prepare routine stains and fixatives	17	1	2	☒	4	5	☒	2	3	4	5
12. Prepare special stains	17	1	2	3	4	☒	1	2	☒	4	5
13. Prepare specimens for shipment	15	1	2	3	☒	5	☒	2	3	4	5
14. Prepare tissue for celloidin embedding and sectioning	5	1	2	3	4	☒	☒	2	3	4	5
15. Prepare tissue for fixation, dehydration, and infiltration of paraffin	13	☒	2	3	4	5	☒	2	3	4	5
16. Section tissue in microscopic blocks	12	☒	2	3	4	5	☒	2	3	4	5
17. Stain Pap smears	16	1	2	3	4	☒	☒	2	3	4	5
18. Stain specimens for microscopic study	18	☒	2	3	4	5	☒	2	3	4	5
19. Submit tissue specimens to AFIP or histopathology centers	11	1	2	3	☒	5	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
M. Performing Cytotechnology Procedures											
1. Coverslip specimens	20	☒	2	3	4	5	☒	2	3	4	5
2. Obtain breast discharge specimens	6	1	2	3	4	☒	1	2	3	4	☒
3. Obtain gastric specimens	11	1	2	3	☒	5	1	2	☒	4	5
4. Obtain pleural fluid specimens	5	1	2	3	4	☒	1	2	3	4	☒
5. Obtain salivary aspirates	7	1	2	3	4	☒	1	2	☒	4	5
6. Obtain surface lesion specimens	7	1	2	3	4	☒	1	2	☒	4	5
7. Obtain urine specimens	12	1	2	☒	4	5	☒	2	3	4	5
8. Prepare fixatives	16	1	2	3	4	☒	☒	2	3	4	5
9. Prepare specimens using millipore	9	1	2	3	4	☒	☒	2	3	4	5
10. Prepare specimens using nucleopore	5	1	2	3	4	☒	1	2	3	4	☒
11. Prepare stains and alcohol dilutions	20	1	2	3	4	☒	☒	2	3	4	5
12. Screen breast discharge smear for malignant cells	7	1	2	3	☒	5	1	2	3	4	☒
13. Screen pleural fluid for malignant cells	8	1	2	3	4	☒	1	2	3	4	☒
14. Screen salivary aspirates for malignant cells	6	1	2	3	4	☒	1	2	3	4	☒
15. Screen spinal fluids for malignant cells	8	1	2	3	4	☒	1	2	3	4	☒
16. Screen sputum smear for malignant cells	7	1	2	3	4	☒	1	2	3	4	☒
17. Screen surface lesion for malignant cells	7	1	2	3	4	☒	1	2	3	4	☒
18. Screen thyroid aspirates for malignant cells	4	1	2	3	4	☒	1	2	3	4	☒
19. Screen urine smear for malignant cells	7	1	2	3	4	☒	1	2	3	4	☒
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure- No decisions	Several procedures- Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
N. Performing Blood Banking Procedures											
1. Accumulate and maintain blood bank statistics	22	☒	2	3	4	5	☒	2	3	4	5
2. Attach serial numbers to units	17	☒	2	3	4	5	☒	2	3	4	5
3. Calibrate centrifuges	12	1	2	3	☒	5	☒	2	3	4	5
4. Centrifuge and separate serum from clot	42	☒	2	3	4	5	☒	2	3	4	5
5. Check and record temperatures of refrigerators and/or alarms	34	☒	2	3	4	5	☒	2	3	4	5
6. Crossmatch blood	39	☒	2	3	4	5	1	2	☒	4	5
7. Dispose of unused blood after expiration time limit	26	1	2	☒	4	5	☒	2	3	4	5
8. Draw blood from donors	21	1	2	3	4	☒	☒	2	3	4	5
9. Maintain blood inventory (e.g. count number of bottles on hand)	29	☒	2	3	4	5	☒	2	3	4	5
10. Maintain donor files	16	1	2	3	4	☒	☒	2	3	4	5
11. Maintain files of blood banking forms including labels	16	1	2	☒	4	5	☒	2	3	4	5
12. Order blood by phone from suppliers	38	1	2	☒	4	5	☒	2	3	4	5
13. Order and maintain reagents and supplies	24	1	2	☒	4	5	☒	2	3	4	5
14. Organize and store blood	27	☒	2	3	4	5	☒	2	3	4	5
15. Perform absorption technique	16	1	2	3	☒	5	1	2	☒	4	5
16. Perform antibody screen and identification tests	36	1	2	☒	4	5	1	2	☒	4	5
17. Perform antibody titers (dilutions)	30	1	2	3	☒	5	1	2	☒	4	5
18. Perform direct and indirect Coombs tests	42	1	2	3	☒	5	☒	2	3	4	5
19. Perform elution technique	15	1	2	3	4	☒	1	2	☒	4	5
20. Perform first aid for shock	11	1	2	3	4	☒	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

N. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
21. Perform genotype of blood	28	1	2	3	☒	5	1	2	☒	4	5
22. Perform transfusion reaction studies	32	1	2	3	☒	5	1	2	3	☒	5
23. Prepare blood for shipment	17	1	2	☒	4	5	☒	2	3	4	5
24. Prepare and read slide agglutination reactions	40	1	2	☒	4	5	1	2	☒	4	5
25. Prepare and read tube agglutination reactions	39	☒	2	3	4	5	1	2	☒	4	5
26. Prepare controls	19	1	2	☒	4	5	1	2	☒	4	5
27. Prepare special blood fractions (e.g., platelet rich blood)	9	1	2	3	4	☒	1	2	☒	4	5
28. Process blood for packed cells	24	1	2	☒	4	5	☒	2	3	4	5
29. Record information on blood record card	26	1	2	☒	4	5	☒	2	3	4	5
30. Screen and schedule donors	14	1	2	☒	4	5	☒	2	3	4	5
31. Store and/or dispose of used blood containers and pilot tubes	22	☒	2	3	4	5	☒	2	3	4	5
32. Take blood pressure of donors and/or pulse rate	13	1	2	3	4	☒	☒	2	3	4	5
33. Test blood for ABO grouping and ABO subgrouping	42	1	2	☒	4	5	☒	2	3	4	5
34. Test blood for Rh or Du factors	43	1	2	☒	4	5	1	2	☒	4	5
35. Use refrigerated centrifuge	11	1	2	3	4	☒	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
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II. MANAGEMENT FUNCTIONS											
A. Organizing and Planning											
1. Assign personnel to duty positions	34	☒	2	3	4	5	1	2	☒	4	5
2. Assign space for equipment and supplies	35	1	2	3	☒	5	☒	2	3	4	5
3. Assign specific work to individuals	41	☒	2	3	4	5	☒	2	3	4	5
4. Assure the availability of equipment and supplies	45	☒	2	3	4	5	☒	2	3	4	5
5. Coordinate activities with hospital administration	16	1	2	3	☒	5	1	2	3	☒	5
6. Coordinate medical-legal problems	9	1	2	3	4	☒	1	2	☒	4	5
7. Coordinate procedures for data processing	10	1	2	3	4	☒	1	2	☒	4	5
8. Coordinate wage and salary administration program	9	1	2	3	☒	5	1	2	☒	4	5
9. Coordinate work activities with other laboratory sections	24	☒	2	3	4	5	1	2	☒	4	5
10. Coordinate work functions of volunteers	8	1	2	3	4	☒	1	☒	3	4	5
11. Coordinate work orders with other departments	19	☒	2	3	4	5	1	☒	3	4	5
12. Design organization or functional charts	15	1	2	3	☒	5	1	2	3	4	☒
13. Determine personnel requirements	17	1	2	3	☒	5	1	2	☒	4	5
14. Develop and/or improve work methods	47	1	2	3	☒	5	1	2	☒	4	5
15. Develop and/or improve laboratory procedures	44	1	2	3	☒	5	1	2	3	☒	5
16. Develop or revise the organization of the section	26	1	2	3	☒	5	1	2	3	☒	5
17. Draft budget estimates	11	1	2	3	☒	5	1	2	3	4	☒
18. Establish organizational policy	12	1	2	3	☒	5	1	2	3	4	☒
19. Establish performance standards	24	1	2	3	☒	5	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

A. (cont.) TASK LIST

		Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
			Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
20.	Establish procedures for special tests	34	1	2	3	☒	5	1	2	3	4	☒
21.	Establish quality control function	36	1	2	3	☒	5	1	2	☒	4	5
22.	Establish research procedures	16	1	2	3	☒	5	1	2	3	4	☒
23.	Establish sanitation standards	10	1	2	3	☒	5	1	2	☒	4	5
24.	Establish work priorities	28	☒	2	3	4	5	1	2	☒	4	5
25.	Formulate standard operating procedures for your medical laboratory	20	1	2	3	☒	5	1	2	☒	4	5
26.	Participate in hospital committee functions	18	1	2	☒	4	5	1	2	☒	4	5
27.	Participate in union contract negotiations	4	1	2	3	4	☒	☒	2	3	4	5
28.	Plan and schedule work assignments	27	☒	2	3	4	5	1	2	☒	4	5
29.	Plan medical laboratory activities	12	1	2	☒	4	5	1	2	☒	4	5
30.	Plan record keeping for the section	28	1	2	3	☒	5	1	2	☒	4	5
31.	Plan reports for the section	21	1	2	3	☒	5	1	2	☒	4	5
32.	Plan status boards or charts	9	☒	2	3	4	5	1	2	☒	4	5
33.	Plan the maintenance and distribution of reports, records, films, or correspondence	16	1	2	3	☒	5	1	2	☒	4	5
34.	Plan the physical layout of the medical laboratory facilities	16	1	2	3	4	☒	1	2	3	4	☒
35.	Plan the section safety program	12	1	2	3	☒	5	1	2	☒	4	5
36.	Plan work flow	25	☒	2	3	4	5	1	2	☒	4	5
37.	Requisition supplies	54	1	2	☒	4	5	☒	2	3	4	5
38.	Requisition equipment	36	1	2	3	☒	5	1	2	☒	4	5
			1	2	3	4	5	1	2	3	4	5
			1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure- No decisions	Several procedures- Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
B. Directing and Implementing											
1. Administer union contracts	4	1	2	3	4	☒	1	2	3	☒	5
2. Direct collection and forwarding of forms and reports	17	☒	2	3	4	5	☒	2	3	4	5
3. Direct the maintenance and utilization of equipment	25	☒	2	3	4	5	1	2	☒	4	5
4. Direct the maintenance and utilization of supplies	27	☒	2	3	4	5	1	2	☒	4	5
5. Direct the maintenance and utilization of work space	24	☒	2	3	4	5	1	2	☒	4	5
6. Direct patient care procedures	12	1	2	3	4	☒	1	2	☒	4	5
7. Direct subordinates in maintaining high standards of personal cleanliness	16	1	2	3	☒	5	☒	2	3	4	5
8. Direct subordinates in maintaining performance standards	29	☒	2	3	4	5	1	2	☒	4	5
9. Direct subordinates in maintaining security standards	15	☒	2	3	4	5	1	2	☒	4	5
10. Direct subordinates in the observance of safety practices	24	☒	2	3	4	5	1	2	☒	4	5
11. Draft and submit job descriptions	17	1	2	3	☒	5	1	2	3	4	☒
12. Interview and evaluate job candidates	19	1	2	3	☒	5	1	2	☒	4	5
13. Maintain files of publications	17	1	2	☒	4	5	☒	2	3	4	5
14. Maintain status boards or charts	10	☒	2	3	4	5	1	2	☒	4	5
15. Resolve staff complaints	22	1	2	☒	4	5	1	2	☒	4	5
16. Resolve technical problems	35	1	2	3	☒	5	1	2	☒	4	5
17. Supervise the safety or disaster control program	9	1	2	3	4	☒	1	2	3	☒	5
18. Supervise the preparation and maintenance of records and reports	19	☒	2	3	4	5	1	2	☒	4	5
19. Supervise subordinate supervisors	12	☒	2	3	4	5	1	2	☒	4	5
20. Supervise bacteriology procedures	14	☒	2	3	4	5	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

B. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
21. Supervise blood banking procedures	15	☒	2	3	4	5	1	2	☒	4	5
22. Supervise chemistry procedures	22	☒	2	3	4	5	1	2	☒	4	5
23. Supervise cytology procedures	8	☒	2	3	4	5	1	2	3	4	☒
24. Supervise endocrinology procedures	5	☒	2	3	4	5	1	2	☒	4	5
25. Supervise hematology procedures	19	☒	2	3	4	5	1	2	☒	4	5
26. Supervise histology procedures	7	☒	2	3	4	5	☒	2	3	4	5
27. Supervise mycology procedures	9	1	2	☒	4	5	1	2	☒	4	5
28. Supervise parasitology procedures	12	☒	2	3	4	5	1	2	☒	4	5
29. Supervise serology procedures	13	☒	2	3	4	5	1	2	☒	4	5
30. Supervise urinalysis procedures	18	☒	2	3	4	5	1	2	☒	4	5
31. Supervise virology procedures	3	1	2	3	4	☒	☒	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
C. Communication											
1. Communicate laboratory findings to physicians	67	☒	2	3	4	5	☒	2	3	4	5
2. Explain laboratory findings to physicians	48	☒	2	3	4	5	1	2	☒	4	5
3. Explain laboratory tests to physicians	49	1	2	☒	4	5	1	2	☒	4	5
4. Explain laboratory tests to hospital staff	38	1	2	☒	4	5	1	2	☒	4	5
5. Explain laboratory tests to patients	34	1	2	3	4	☒	1	2	☒	4	5
6. Instruct patients	45	☒	2	3	4	5	1	2	☒	4	5
7. Interpret laboratory functions and policies to hospital personnel and/or volunteers, Board, etc.	19	1	2	3	☒	5	1	2	☒	4	5
8. Participate in hospital public information program by gathering and furnishing appropriate data	10	1	2	3	4	☒	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
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D. Inspecting and Evaluating											
1. Determine equipment repairs or replacements needed	49	1	2	3	☒	5	1	2	☒	4	5
2. Evaluate adherence to work schedules	21	☒	2	3	4	5	1	2	☒	4	5
3. Evaluate compliance with established work standards	22	☒	2	3	4	5	1	2	☒	4	5
4. Evaluate individuals for promotion and upgrading	21	1	2	3	☒	5	1	2	☒	4	5
5. Evaluate procedures for storage, inventory, and inspection of property items	20	1	2	3	☒	5	1	2	☒	4	5
6. Evaluate the accuracy of routine reports	37	☒	2	3	4	5	1	2	☒	4	5
7. Evaluate the adequacy of routine reports	30	☒	2	3	4	5	1	2	☒	4	5
8. Evaluate the maintenance and use of equipment	37	1	2	☒	4	5	1	2	☒	4	5
9. Evaluate the maintenance and use of supplies	32	1	2	☒	4	5	1	2	☒	4	5
10. Evaluate the maintenance and use of work space	25	1	2	3	☒	5	1	2	☒	4	5
11. Evaluate work performance of subordinates	29	1	2	3	☒	5	1	2	☒	4	5
12. Initiate reports on unsatisfactory equipment	34	1	2	3	☒	5	1	2	☒	4	5
13. Inspect and evaluate adherence to established standards of sanitation, cleanliness, and neatness	17	☒	2	3	4	5	1	☒	3	4	5
14. Inspect and evaluate the maintenance of status boards or charts	10	1	2	☒	4	5	1	2	☒	4	5
15. Inspect the physical layout of the medical laboratory facilities	12	1	2	3	☒	5	1	2	☒	4	5
16. Investigate possible sources of staphylococcus and/or other hospital infectious diseases	15	1	2	3	☒	5	1	2	☒	4	5
17. Recommend special corrective action for recurring problems	24	1	2	3	☒	5	1	2	☒	4	5
18. Resolve personal problems of subordinates	23	1	2	3	☒	5	1	2	☒	4	5
19. Resolve technical problems of subordinates	33	1	2	3	☒	5	1	2	☒	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
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E. Training and Education											
1. Administer written or performance tests	20	1	2	3	☒	5	1	2	☒	4	5
2. Arrange for teaching aids, space, and equipment	20	1	2	3	☒	5	1	2	☒	4	5
3. Conduct conferences and classes	23	1	2	3	☒	5	1	2	☒	4	5
4. Develop curriculum, training materials	18	1	2	3	☒	5	1	2	3	☒	5
5. Evaluate training effectiveness	18	1	2	3	☒	5	1	2	☒	4	5
6. Give instruction in accredited education programs	18	1	2	3	☒	5	1	2	☒	4	5
7. Give on-the-job instruction in medical laboratory activities	46	1	2	3	☒	5	1	2	☒	4	5
8. Give training or lectures to non-medical laboratory personnel	15	1	2	3	4	☒	1	2	☒	4	5
9. Interpret policies and directives to subordinates	23	1	2	3	☒	5	1	2	☒	4	5
10. Maintain performance records	22	1	2	3	☒	5	1	2	☒	4	5
11. Orient newly-assigned personnel	40	1	2	3	☒	5	1	2	☒	4	5
12. Recommend individuals for training	17	1	2	3	☒	5	1	2	☒	4	5
13. Recruit students	9	1	2	3	4	☒	1	2	☒	4	5
14. Review training progress of individuals	18	1	2	3	☒	5	1	2	☒	4	5
15. Review training status of the section	14	1	2	3	☒	5	1	2	☒	4	5
16. Rotate and assign students	15	1	2	☒	4	5	1	2	☒	4	5
17. Rotate duty assignments of personnel	18	1	2	☒	4	5	1	2	☒	4	5
18. Schedule on-the-job training	11	1	2	3	☒	5	1	2	☒	4	5
19. Select and assign instructors	8	1	2	3	☒	5	1	2	3	4	☒
20. Select individuals for specialized training courses	10	1	2	3	☒	5	1	2	☒	4	5

APPENDIX Q

TOTAL SAMPLE (N=224)

PERCENT PERFORMANCE AND FREQUENCY AND DIFFICULTY MODES OF TOTAL SAMPLE

E. (cont.) TASK LIST	Percent Performance	FREQUENCY MODE ☒ How often do you do this task?					DIFFICULTY MODE ☒ How difficult is this task?				
		Daily / Almost Daily	Several times a Week	Several times a Month	Several times a Year	Almost never	Routine procedure-No decisions	Several procedures-Minor decisions	Select most Suitable procedure	Establish and/or Modify procedure	Make complex decisions Little precedent
21. Select textbooks and library reference materials	25	1	2	3	☒	5	1	2	☒	4	5
22. Show how to locate and interpret technical information	23	1	2	3	☒	5	1	2	☒	4	5
23. Supervise on-the-job training programs	21	1	2	3	☒	5	1	2	☒	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
F. Maintaining Supplies and Records											
1. Handle property turn-in	8	1	2	3	☒	5	1	2	☒	4	5
2. Log incoming or outgoing specimens	38	☒	2	3	4	5	☒	2	3	4	5
3. Maintain and revise stock levels	31	1	2	☒	4	5	☒	2	3	4	5
4. Maintain files of clinical laboratory requests	24	☒	2	3	4	5	☒	2	3	4	5
5. Maintain files of laboratory correspondence	21	1	2	☒	4	5	☒	2	3	4	5
6. Maintain files of laboratory records or reports	35	☒	2	3	4	5	☒	2	3	4	5
7. Prepare work orders or work requests	22	1	2	☒	4	5	1	2	☒	4	5
8. Procure and store biological items	20	1	2	☒	4	5	1	2	☒	4	5
9. Purchase supplies	26	1	2	☒	4	5	☒	2	3	4	5
10. Receive incoming supplies	49	1	2	☒	4	5	☒	2	3	4	5
11. Requisition supplies	49	1	2	☒	4	5	☒	2	3	4	5
12. Supervise the maintenance of laboratory supplies	29	1	2	☒	4	5	1	2	☒	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5
		1	2	3	4	5	1	2	3	4	5

APPENDIX R

ROSTER

NATIONAL TECHNICAL ADVISORY COMMITTEE
FOR CLINICAL LABORATORY OCCUPATIONS

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(Representing American Society of Clinical Pathologists)
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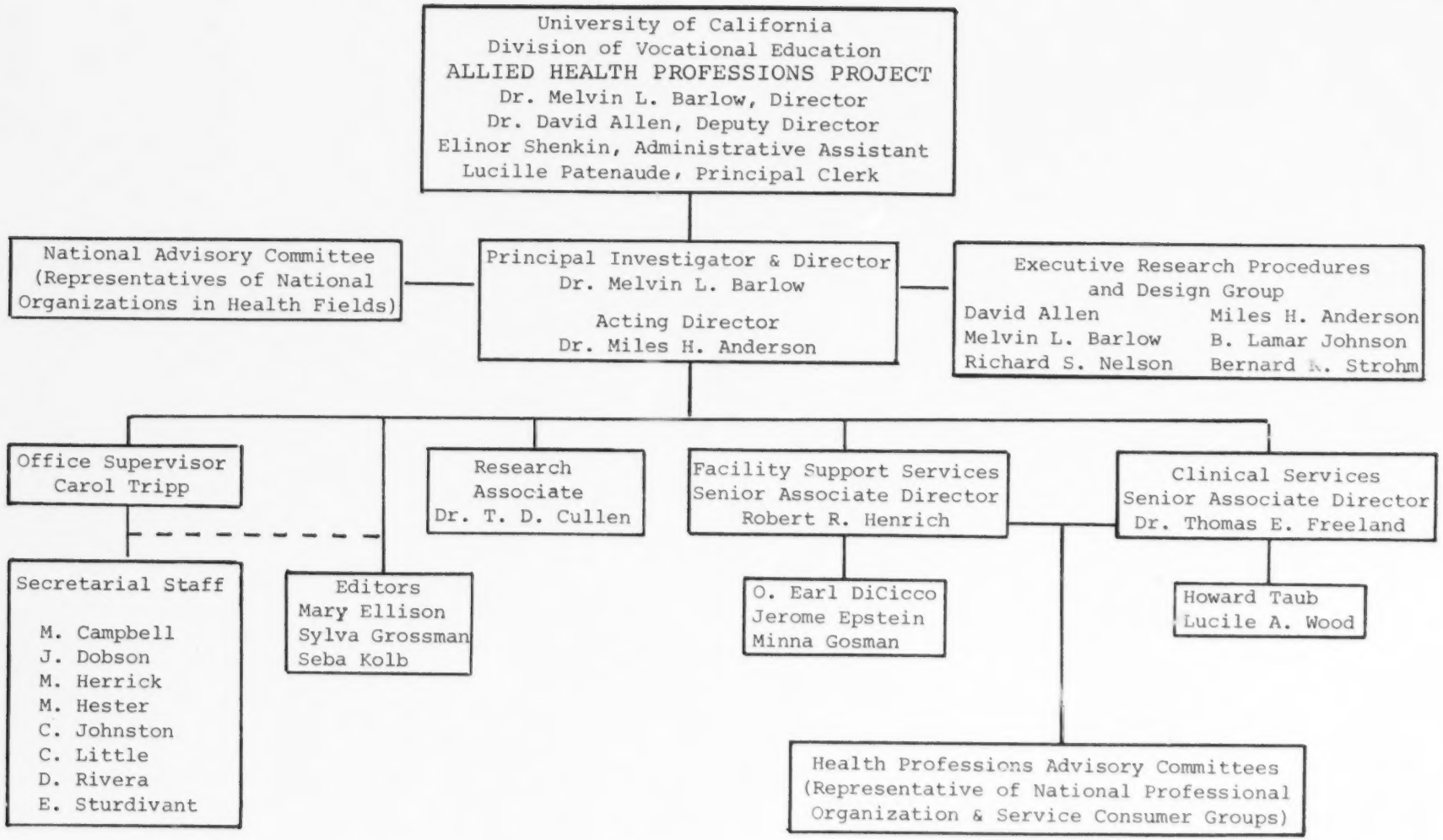
* Named to Committee after development of task list.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